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INSECT ODDITIES.—I.

By E. A. BUTLER, B.A., B.SC.

WHILE hardly any great division of the animal kingdom is devoid of species that exhibit fantastic and outlandish forms, the class Insecta is perhaps furnished with more than its fair share of these. We have already discussed in these papers some few of these extravagances of form, especially in the development of the limbs, and some good reason was generally found to be assignable for the quaintness of structure they exhibited. But even in the comparatively limited fauna of the British Islands, there are plenty of others which exhibit an equal, or even greater, bizarrerie, for which it is less easy to find an adequate reason. It may safely be affirmed that the order Rhynchota, or bugs and frog-hoppers, is more productive than any other group of the extraordinary forms to which we allude, and it may not be without interest to direct attention to a few of these oddities, which, although sometimes not of the commonest occurrence, will yet hardly fail to strike the observer when he does happen to meet with them.

The first that calls for notice is a little creature of such weird aspect that one can scarcely be surprised at its having been associated by country folk with the powers of darkness. Its scientific name is *Centrotus cornutus*, and amongst the peasantry of France, its dark colour combined with the sinister appearance of its fore-parts has gained for it the sobriquet "*Le Petit Diable*," while an English author speaks of it and its relatives as "Fiend-Flies," and an American entomologist describes them as "Brownie-bugs." *Centrotus* is not a very large insect, being only about $\frac{3}{5}$ of an inch long, and, moreover, it belies its appearance by being perfectly harmless. When viewed in front (Fig. 1, A) it seems to show a brownish black

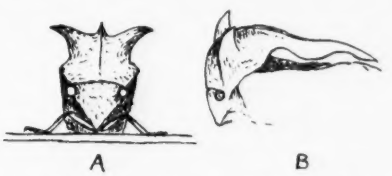


FIG. 1.—A, Front view of Face and Prothorax of *Centrotus cornutus*. B, Side view.

vertical face surmounted by a pair of curved horns, and this was quite enough in mediæval days to suggest a Satanic association. But it is not really the head to which this formidable appearance is due. The head in fact is neither very large nor conspicuous save for the rather large and wicked-looking eyes; but the prothorax has taken on the most grotesque form, rising perpendicularly above the head, surmounting it as with a head-dress. This head-dress runs out into the aforesaid horns at the side, while between them there is a little ridge which, if we follow it backward, we see gradually extending and enlarging till it forms a long sword-like appendage (Fig. 1, B) reaching nearly to the end of the body, and looking like a sort of stiff puggaree to the aforesaid head-gear.

There is nothing remarkable about the rest of the insect, It has four ordinary membranous glassy-looking wings with distinct nervures, the upper pair being stouter than the lower, and its legs and body are quite normal in shape. It is simply this extraordinary development of the thorax that makes it such a wild and odd-looking being. It is impossible to say whether this quaintness of form has any bearing upon the insect's present mode of life, or is in any way in correspondence with its usual environment. It is an inhabitant of woods, living amongst the herbage, chiefly in our southern counties, but too little is known of its habits for it to be possible to give any adequate explanation of its form. It belongs to one of those orders of insects which do not undergo any very great change of form during the course of their life, and which never pass into the quiescent stage of neither taking food nor moving about—in other words, its metamorphosis is of the kind known as "incomplete." The young insect is shaped something like the adult, but of course has no wings, and the thoracic horns and tail do not attain their characteristic form till the last moult. It is a vegetarian in diet, sucking the juices of plants through a short beak, and is therefore probably mild and inoffensive in its ways, so that the only use one can suggest for its curious armature is that it should act as a terror-producing signal upon any would-be assailant.

In other parts of the world, other species are found, more or less closely allied to this, in which the thorax

presents far more grotesque developments than in the present case. They constitute the family *Membracidæ*, of the sub-order Homoptera, and it would be difficult to find any other family of insects in any order which can show an equal range of fantastic development of the thorax, or, for the matter of that, of any other part of the body. Horns, spines, hooks, knobs, forks, blades—every conceivable monstrosity may be found in the exotic members of this family, and one would think that Nature must have been in a sportive mood when she made them. Speaking of some American species, a well-known authority says: "If the young naturalist wants to laugh, let him look at the faces of these brownie-bugs through a lens. Their eyes have a keen droll look, and the line that separates the head from the prothorax gives them the appearance of wearing glasses. In some cases the prothorax is elevated above the head, so that it looks like a peaked nightcap; in others it is shaped like a Tam o' Shanter, while others have prominent horns."

In our next example it is the head instead of the thorax that has developed grotesquely. The insect is called *Eupelix cuspidata* (Fig. 2), and it belongs to the same order Homoptera as our first example, though to a different family. It is a very different insect from the preceding, being smaller and narrower, and of a pale yellowish brown colour. There is nothing at all remarkable about it except the head, which is certainly a most extraordinary structure. It is shaped very much like a miner's shovel, running far forward as a thin and flattened triangular plate, scooped out in the middle of its disc, slightly rounded at the edges, and turned up at the tip. This leaf-like appendage is slightly transparent, and is often prettily marked with a series of blackish mottlings which give it somewhat the appearance of black lace. The wings when closed are placed along the sides of the body in a nearly vertical position, and their surface is in some instances more or less plentifully sprinkled with minute blackish dots, as though it were slightly dusty. The large compound eyes are situated in the hinder part of the head, and the curious shovel-like plate passes right in front of them, and in fact bisects their surface, leaving part of each eye above and part below its level. One would think that this arrangement must interfere with vision, at least in the forward direction, though no doubt the insect has an unimpeded range of view on each side. The exact shape and size of the shovel part of the head varies a good deal, so much so indeed that different names have been assigned to the different forms under the belief that they were distinct species. However, as it is possible to find large and small heads, as well as intermediate ones, in the same batch at the same spot, it seems more probable that all the differences of form are mere variations within the limits of a single species.

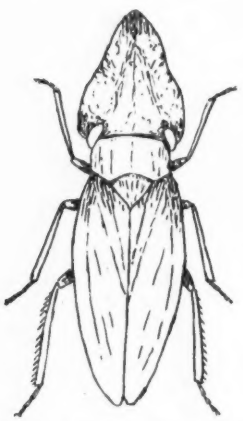


FIG. 2. *Eupelix cuspidata.*

It is impossible to say what is the reason for this curious conformation of the head. Practically nothing is known of the habits of the insect, save that it lives amongst low plants, grasses and the like, especially in dry sandy places. In all likelihood there is little else to be known; they probably live very uneventful lives, and in spite of their peculiar shape, they can hardly be very important factors in the general scheme of things, or have any very great influence in nature. Their numbers are not large, and the amount of sap they consume in the course of their lifetime is no doubt infinitesimal, so that there is perhaps some justification for the contempt expressed for them by a countryman to whom I once showed some specimens when he came upon me in the act of collecting them. His fancy was greatly tickled at the thought that an otherwise apparently sane individual should so far forget his dignity as to go down on his hands and knees in the open country and grovel amongst the roots of mere weeds for what the interlocutor was pleased to call "barley-corns," and he was fain to call the attention of another rustic to the strange phenomenon, so that they might enjoy a laugh together at the expense of the mad naturalist.

Within this same order Homoptera there is still plenty of scope for finding other oddities, and the next we shall select is called *Ledra aurita*. This is almost the largest species of Homoptera we possess in the British Islands; there is in fact only one that is larger. It is at least $\frac{5}{8}$ inch long, and is found, though not very frequently, in oak-woods. It has a thin, flat head, somewhat after the fashion of *Eupelix*, though not nearly so large as in that insect; but the greatest peculiarity, and that which gives it its name *aurita*, "eared," is a couple of large flaps which rise from the back of the prothorax, one on each side, like ears. The aspect of the insect changes very much according to the position in which it is viewed, and it is not easy to say which is the best to show off its characteristic peculiarities. Perhaps a view taken from the front, and a little to one side, will reveal most effectively the relative position and odd forms of the most strangely shaped parts, and such a view is given in the figure (Fig. 3).

This insect is the solitary representative of its family, and as such, therefore, can hardly be mistaken. It is of a brownish colour tinged with green, but the green tint soon goes off when the insect is dead, and it then appears entirely of a dirty brown, lighter or darker as the case may be. Its hind legs are peculiar, being very much broadened, and ornamented on the outer edge with a dense fringe of fine hairs, as if it had been intended to be a swimming insect. Its larva is, if possible, a stranger looking creature than itself, and were it not for its large and broad hind legs, proportionately broader even than in the adult, it might almost pass muster as a woodlouse. The old naturalist Geoffroy, who describes our first insect as "*Le Petit Diable*," calls the present one "*Le Grand Diable*."

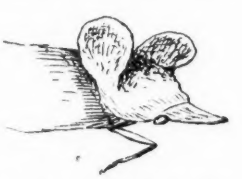


FIG. 3.—Side view of fore-parts of *Ledra aurita.*

Still keeping to the order Homoptera, we may next select the insect called *Asiraca clavicornis* (Fig. 4). This, again, is not often met with, though when seen it cannot be mistaken. It is found amongst low herbage in dry places, and is most readily obtained by sweeping such herbage with a strong net. But even when a specimen is in the net, it is by no means a foregone conclusion that the collector may call it his own, for the little creature is an excellent jumper, and darts nimbly about in the most instantaneous manner in totally unexpected directions, and hence its final capture is not always the easy process that might be imagined. For the quaintness of this insect's appearance, it is especially the first two pairs of legs and

the antennæ that are responsible. The fore-wings are glassy and transparent, with their nervures marked with dark dots, from each of which springs a stout hair, and in these features *Asiraca* is only a somewhat exaggerated repetition of its relatives. But though the wings are of almost normal type, the antennæ have run into an extravagance of form, projecting from the sides of the head like a couple of drumsticks. Their basal joint is a long, flattened, angular piece of apparatus, which is succeeded by a sort of knob, and this again is crowned with a long and tapering black bristle. The fore-limbs, however, are the strangest part of the whole anatomy; their thighs and shanks, which are in the main dark-coloured, are enormously broadened and at the same time flattened; the shanks taper away almost to a point, irresistibly reminding one of the peg-top trousers of forty years ago, and their extreme tip is almost white. This little white patch is followed by the minute and dark-coloured foot, and thus by its being sandwiched in between two dark patches, a striking and artistic contrast is displayed. The second pair of legs are very similar, but not quite so broad. It has been suggested that these curious legs may be of use to the insect in making its way about in the narrow spaces near the roots of the rough herbage it frequents, but apparently this is no more than speculation.

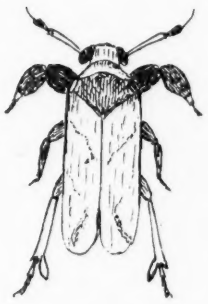


Fig. 4.—*Asiraca clavicornis.*

Our next example shall be from the allied sub-order Heteroptera, which goes with the Homoptera to make up the order Rhynchota. It is called *Verlusia rhombea* (Fig. 5), the specific name *rhombea* referring to the curious angular shape of the abdomen, which is just that of the geometric figure known as a rhombus. It is a yellowish-brown insect, with its upper wings partly stiff and horny, and partly thin and membranous, and its lower pair wholly membranous. When the wings are opened the body is seen to be of a deep yellow colour, with a black velvety patch at the base. The body is very thin and flat, but the expanded angular margins bend slightly upwards, so that even when the wings are closed and fitting tightly over the body, these margins still form the highest points, and the rest of the body lies down as it were in a hollow. A rather important result follows from this peculiar configuration. If an insect in the course of its daily occupations should happen to fall on its back, it often finds some little difficulty in righting itself. If the back is convex and the legs are fairly long, a few wild struggles, by pushing with the legs on one side and using those of the other as a prop, will generally manage to tilt the creature up, till at last it topples over and rejoices to find itself right side uppermost. But if the back be flat, or worse still, concave, and the legs short, the task is far more difficult, and its accomplishment often depends upon some special mechanical contrivance, more or less ingenious. *Verlusia* is an example in point. From the thinness and concavity of the body, together with the elevation of its margins, it follows that if this insect has the misfortune to be capsized, its chances of righting itself in the ordinary way would be rather remote, and but for some other arrangement, it might have to remain indefinitely sprawling on its back, kicking its legs in the air. But it is then that we see one of the uses of the extremely thick and clumsy looking antennæ, which are a good deal stouter and stronger than the legs themselves. By pressing the tips of these on the ground, the bug manages to hoist itself up till it is supported on a tripod consisting of these two tips and the end of the body. Then, by suitable shiftings of one or other of the antennal props, aided by struggles with the legs, it at last overbalances, and so returns to the normal position. Apparently, therefore, in this case there is a co-ordination between the shape of the body and the structure of the antennæ which cannot be accidental, though one would not hesitate to admit that there may be other reasons also for the flatness of the one and the stoutness of the other.

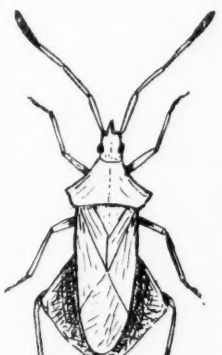


Fig. 5.—*Verlusia rhombea.*

Our next oddity is a lovely little being belonging to the same sub-order, and representing a family of which we have in this country about twenty species, some of them very abundant, others equally rare. They form the group of small insects generally known as Lace-Bugs, from the peculiar formation of their wing-covers. Of this group, our selected representative, *Derephysia foliacea*, is certainly the most remarkable in shape and appearance. As all its beauties and peculiarities are crowded into a length of not more than $\frac{1}{8}$ of an inch, a hand lens, or even a low power of the compound microscope, is needed to give a true idea of its form. Applying such aids to vision, we see that its little head is overarched by a sort of helmet or cowl, composed of transparent membrane, which is divided up into a few distinct areas by strong brownish nervures. This hood is really a part of the prothorax, and from it there run three upright keels of the same material down across the little black thorax. From the sides of the thorax rise, like an Elizabethan ruff, two similar stiff, broad membranes, each rendered net-like in appearance by the nervures which divide it up into cell-like areas. The upper pair of wings, again, is made of the same sort of lace-like membrane; their central area is raised, as are also the outer margins, which stretch considerably beyond the body and seem to continue the line of the thoracic frill. Thus the whole insect seems to be not only covered with lace, but also surrounded by a deep frill of the same material, and the glassy membrane which fills the meshes of the lace glitters as the insect moves and the light falls on it in different directions. No drawing is here given of this little bug, as none can do justice to it, or show its real form, which must be seen under the compound microscope to be fully appreciated.

These delicate little beings are fairly common, and may be found by anyone who will take the trouble to look for them. They are retiring in habits, and do not court notice. But those who are willing to spend a few hours searching in likely spots, to turn over dead leaves or other rubbish in woods or by roadsides and under hedges, or to beat ivy, holly and other dry bushy vegetation over a net, will be sure to be rewarded for their trouble by finding specimens, whose movements can then be watched at leisure. Those who do not care to undertake such a search, but would still like to see creatures similar to this in a state of nature, may easily do so by searching the flower heads of that common weed, the Scotch thistle. There is one particular lace-bug, called *Monanthia cardui*, which lives on these thistle-heads, lying among the scales

on the rounded part outside, and it is sure to be found wherever the thistle occurs. Though it is a very pretty insect, and will give a good idea of what a lace-bug is like generally, it is neither so elegant nor so quaint in form as the little *Derephysia* described above.

For our last oddity in the present paper, we must go to a weedy pond, and search for the little water-bug called *Plea minutissima* (Fig. 6). We pull out a mass of the water weeds, and spread them out on a piece of macintosh. We soon notice some little fat whitish bodies moving slowly about amongst the weeds; these are the objects of which we are in search, though they do not at first sight seem to be insects at all. If we separate one of them from the wet mass, let it dry itself, and bring a hand lens to bear upon it, we find it is really a six-legged being, and therefore an insect, though its legs are not very noticeable, as they are kept near the body and are of the same pale colour. It has a head as broad as the body, with two large masses of eyes at the sides, and a very humped back, which descends almost perpendicularly behind, making the little being look like a very short and tubby inverted boat. Very close scrutiny will reveal a sloping line on the visible wings, dividing their area into two parts, the clavus and corium of the ordinary bug type. Turning it over on its back, we note the little beak, which confirms the indications of the wings, that it is a Hemipteron. The whole surface is indented with little pits, as though it were grievously pock-marked. This odd little being is a near relative of the water boatman, and often occurs by hundreds in our ponds, where it lives an uneventful life amongst the weeds.

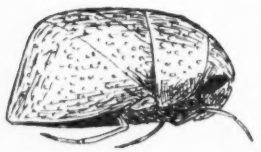


FIG. 6.—*Plea minutissima*. Side view.

Thus all the oddities we have considered in this paper belong to the one order Rhynchota, or Hemiptera, in either one or other of its sections, the Heteroptera, or bugs proper, and the Homoptera, or frog-hoppers. In our next paper we shall consider some oddities belonging to other orders.

THE AIR OVER LONDON.

By the Rev. JOHN M. BACON.

As long ago as 1842, John Wise, of America, made an important statement respecting general upper currents which I believe will be fairly universally accepted at the present day. Wise adopted the career of a professional aeronaut, starting with no previous training, and there being no experts at that time in his own country his investigations and deductions were from the beginning wholly independent. He built his experimental balloon of mere longcloth, invented his own varnish, and, step by step, collected his facts with intelligent diligence not to be surpassed. At the end of a career of many years he convinced himself of the possibility of crossing the Atlantic in a balloon of adequate size, and applied to Congress for funds to make the attempt, stating in his own words:—"It is now beyond a doubt in my mind established that a current from west to east in the atmosphere is constantly in motion within the height of 12,000 ft. above the ocean."

I have always looked upon this as a very valuable, practical and independent confirmation of the theory with which we are now familiar, namely, that somewhere, and as it would seem at an accessible height, there is a general air stream in our latitudes following the direction of the earth's rotation. It is to this general and moderately lofty upper west wind that, in my opinion, we must refer certain important conditions which can be readily noted by the man in the street with regard to the air above London.

It would seem a common rule that when contrary lower winds meet and mingle with this upper current the air aloft grows hazy, robbing direct sunlight of much of its intensity; while, on the other hand, with lower westerly winds Londoners may look for their clearest air, and this not only for the above reason but also because of the blowing away from London proper of the smoke of the city. As to the dissipation of smoke I shall have a word to add presently. However, with regard to a certain condition of exceptional clearness over the east side of London, it has been stated as the result of long-continued observation at Greenwich, that whereas over and beyond the river to the N. and N.N.E. there is usually hazy distance, this haze is occasionally replaced by remarkable clearness, at which times rain is the invariable consequence before the next morning. Under such circumstances we cannot suppose the clearness to be attributable to west winds, which, as some meteorologists maintain, by their moisture cause absorbent dust particles to become too heavy to remain in suspension; for west currents in the present case would assuredly bring with them smoke clouds gathered from all London.

It would be interesting to investigate what would be the nature of the air if analysed at a time when great visibility is manifest, at the average height at which haze is usually detected; and here I am able to give a few results gathered when chances have afforded me the opportunity. Such chances are of course rare, for, in the first place, the occasions when a balloon voyage can be made fairly over London are infrequent, and the whole period of a flight overhead being limited it may well happen that the short time at disposal may have to be devoted largely to other matters.

Three times, however, during last summer I sailed directly and leisurely over London, at moderate but varying heights, when I was able to make observations both as to haze and also as to palpable dust in suspension; while I have made many similar observations from some of the highest accessible buildings. I would first call attention to the fact that a series of photographs makes evident—what indeed was patent to the eye—that haze, as viewed from aloft, hung persistently over certain quarters, such haze having no reference to the angle of illumination. For example, in an aerial travel at about four thousand feet altitude over the heart of London from the south-west to the north-east, keeping the eye always S. and S.E., at the start the river at Chelsea and the Surrey shore were perfectly clear, as in due course were also Trafalgar Square and Westminster, and again later, remarkably so, the region east of London Bridge. But over St. Paul's, Blackfriars, and as far as Southwark Bridge, a thick haze prevailed. In the next place, photographs from lofty buildings show how on many occasions a haze which blotted out the town late in the evening, and again early the following morning, was strikingly absent through night hours. The illustration given affords an example of this. It was taken during a January night, and shows great clearness of atmosphere, whereas from similar, as also from lesser heights, photographs taken the afternoon before and the forenoon following showed no definition whatever.

With regard to dust in suspension over the town, my observations go to show that in calm weather this will hang at certain levels in strata, or, as I am led to believe,

not infrequently in definite clouds which yield to influence of breeze, which are higher in dry and lower in moist weather, and which are largely washed out of the air by summer showers. I have often found that at some height,

Photograph of New Oxford Street, London, showing St. Giles' Church. Trails of light from passing vehicles alone visible. Six hours' exposure.

generally about 6000 feet, it is possible to surmount the haze and look down upon its surface as though the grosser matter in suspension had a definite upper limit. Above this limit the day sky wears a darker blue and at night the stars redouble their splendour.

As to the actual nature of the dust collected and examined I have certain information to give. Dr. Angus Smith, who used methods very similar to my own, discovered besides formless matter actual crystals in the air under certain circumstances, metallic matter in the form of dust resembling rolled or torn plates of iron in railway carriages, and so on. High over London I have found nothing of this nature, but I have met with a great quantity of such dust as will settle by night on the furniture of a room together with much of altogether larger dimensions resembling chaff, filaments, and woollen fibre; such dust, in fact, as would arise off the thoroughfares in dry weather, or from the sweeping out of houses. But such dust was more in evidence at from 3000 to 5000 feet above the house-tops than nearer the ground. It would seem to accumulate at the higher levels, and then in anti-cyclonic conditions when mixed with smoke and under circumstances favouring fog one would like to know exactly what part this dust-laden canopy plays.

When the fog comes down it often begins with the down-rush of a dense mass which when viewed from a lofty building seems to swamp the lower roofs as with a murky wave. This presently lifts again into space, but only to return again and again till it finally settles down and the fog becomes uniformly dense and general. These conditions I have photographed from various heights up to that of the golden gallery of St. Paul's, but the results, though highly instructive, do not lend themselves to reproduction.

As to the far travel of London smoke when it is not detained in fogs over the city, there is plenty of evidence forthcoming. In days of bright sunshine in the open country the fairest and most-favoured suburbs of the West End may be partially over-clouded if an east wind causes London smoke to set in that direction. This same smoke may be actually seen at thirty miles to leeward, and when it drifts away as London fog it may be smelt for twice that distance. The smoke from the Black Country has been stated to be carried down the wind over vast areas, a fact which must of course be open more or less to conjecture, but I can speak from ocular evidence of the extraordinary passage of smoke travelling far and wide, but not ascending more than a very moderate height into the sky. It was on a calm clear night last summer that I made a night voyage over London, starting at 3 a.m. With gradually increasing altitude, Fulham was crossed, then the suspension bridge at Battersea, next Lambeth and Peckham, and so out over Kent. As far as could be discerned, London proper at all heights was as free from smoke as can be conceived, but when the town was left far in our wake our course took us over some cement works, whose chimneys were pouring volumes of smoke into the sky. This smoke, however, as viewed from our level of 4500 feet, seemed to rise no considerable height anywhere into the atmosphere; on the contrary, it rapidly spread into a low-lying layer, and then travelled outwards without sensible thinning away as far as the eye could reach. At twenty miles distant it was on the earth, still making itself unpleasantly manifest.

In the above case, of course, the smoke was drifting away as fast as formed, and no dense accumulation over the land was possible. Had the air been quiescent the case would have been very different, and it may not be difficult to form a reasonable conception of what the air over London might be found to be if explored by balloon at a time of visitation of fog. As to what may be observed from the highest accessible point of St. Paul's I can record some experiences. On many days of moderate fog you may be able to climb above the actual fog limits, but in the exceptional fogs preceding last Christmas this was not so. Under these circumstances what are the actual dimensions and conditions of the fog? In one of the early numbers of KNOWLEDGE, R. A. Proctor points out by mathematical reasoning, depending on the amount of light that even in densest fogs actually does struggle through from the clear sky above, that the depth of the fog layer cannot be very great. And this seems probable on every account. Particles of carbon, being good radiators, must readily reach the dew point, and becoming heavy with deposition of moisture, must in circumstances of fog be incapable of rising high into the atmosphere.

But if the fog be shallow, it is moreover presumably in a condition of instability. The fog itself checking radiation, there must be considerable difference of temperature between its lower and upper limits. Nor is this all; the alternations of warm and cold air streams so often recorded in balloon ascents, and also deduced from kite experiments, are in my experiences, which are now not few, very frequently met with above a cloud layer. Such alternations seeming indeed to be often independent of visible cloud, and in ascents over London they are possibly more noticeable than over the open country. (This might indeed be inferred as probable when the variations of radiation from a town like London are considered.) Under these circumstances we may suppose that some small source of disturbance might be sufficient to cause the densest fog to break away upwards, or, in the common phrase, to "lift" in that magical manner so often observed.

One other factor operative in the dispersal of fogs should not be left out of account, namely, the diverse upper currents so often encountered over London. Charles Green called attention to these as far back as 1838, when at less than half a mile above the earth his course

changed through N.W., N., and N.E. within the limits of the metropolis. I would submit that these varying currents are the rule over London.

THE NUMBER OF MOULTS UNDERGONE BY DRAGON-FLY NYMPHS.

By the Rev. ARTHUR EAST.

THERE appear to be so few observations of the number of times that the nymphs of dragon-flies change their skins —indeed, so far as the writer is aware, the exact number is unknown—that possibly a few notes on the ecdysis of *Æschna cyanea* may be acceptable to that small, but increasing number of students who devote some attention to that interesting group of insects known as the Odonata.

The moults in the later stages of the nymph's growth are very easily observed and counted, but it is the earlier ones, and especially the earliest of all, where the difficulty comes in. This, of course, is owing mainly to the insects being aquatic in the nymphal stage, and also to the minuteness of the eggs of even the largest dragon-flies; added to this there is the difficulty of keeping the imagines in captivity so as to make the females deposit their eggs where they can be kept under observation, and the additional fact that when the minute eggs are laid, they are either secreted beneath the cuticle of aquatic plants or else dropped at random into the water. Accident, however, comes sometimes to the rescue.

There was found in an aquarium in July an excessively minute and solitary nymph of *Æschna cyanea*, measuring only 6½ mm. in length, and in addition there were three still more minute cast nymph skins, measuring respectively 3½ mm., 5 mm., and 6½ mm., evidently belonging to this same nymph, as the water had been unchanged since January. The smallest skin, measuring 3½ mm., was possibly the first or second skin cast. A writer in the December number of the *Entomologist*, referring to this particular instance, says "A very few minutes after leaving the egg, some young nymphs moult. This I have observed in *Libellula quadrimaculata* (at Jena, Germany, in June, 1896) and in our American *L. pulchella* and *Sympetrum vicinum*. It is also mentioned for *Epitheca bimaculata* by Heymons (1896). It is likely that such a moult will be found to occur in *Æschna*. Previous to this first moult, the legs of the young nymph are adherent to each other and are not movable, so that Heymons says that we cannot yet speak of a larva, but of a hatched embryo. The first moult frees the legs, which are at once put into use by their possessor.

The day following that on which the nymph was first discovered it changed again, and became 10 mm. in length; on Augsut 3rd, it became 13 mm.; on August 15th, it became 18 mm.; and at this, its sixth moult, the four rudimentary wing-cases first appeared.

Nymph of *Æschna cyanea* after the 6th moult, showing first appearance of wing-cases.

The seventh moult was on August 25, when the nymph measured 20 mm, the rudimentary wings were further developed, and, strangely, there could be seen through the transparent skin the wing-cases of the next moult, now for the first time advanced from the sides and lying touching one another on the median line of the back.

Then followed a change on September 22, when the nymph measured 25½ mm., and after this a long rest of four months to January 24, when the measure became 29 mm. Unfortunately during the winter this nymph died, and there had to be substituted *Æ. cyanea II.*, measuring, however, exactly 29 mm., three others of the same measure being kept in reserve in case of disaster. No disaster occurred, happily, and *Æ. cyanea II.* completed her course (for the nymph was a female) without accident. The subsequent changes and measurements were as follow:—10th moult, May 5th, 32 mm.; 11th moult, June 6th, 38 mm.; 12th, final emergence of the imago, July 14th, the nymph having reached 43 mm.

The number of moults undergone will therefore be twelve, supposing that the smallest skin found was that of the first moult, if of the second moult then the total number must be advanced one, making thirteen as the number.

For convenience of reference the whole observation may be given in tabular form—

? 1st moult,	date unknown,	measure 3½ mm.
2nd moult,	date unknown,	measure 5 mm.
3rd moult,	date unknown,	measure 6½ mm.
4th moult,	July 31st,	measure 10 mm.
5th moult,	August 3rd,	measure 13 mm.
6th moult,	August 15th	measure 18 mm.
7th moult,	August 25th,	measure 20 mm.
8th moult,	September 22nd,	measure 25½ mm.
9th moult,	January 24th,	measure 29 mm.

On April 30th, substituted another nymph in place of original one, which died.

10th moult, May 5th, measure 32 mm.
11th moult, June 6th, measure 38 mm.
12th and final, July 14th, nymph measured 43 mm.

From this it will be seen that there is a fairly even growth, on an average, of 4 mm. for each ecdysis, but that for nearly eight months, viz., from September 22nd to May 5th, there was only one moult. This was not owing to lack of food, as worms were frequently offered, nor was the nymph at all torpid; one can only suppose that it is a necessary arrangement, as food must ordinarily be extremely difficult to obtain during the winter months.

That the nymph should die during the observation was unfortunate for both observed and observer, but the cause showed very clearly the extreme value of that wonderful endowment possessed by these creatures of being able to breathe at will either the air dissolved in the water, or common air at the surface, as referred to in a previous article on this subject.* The small aquarium in which the nymph was kept had been cleaned, and the sides were no longer rough with green algæ as before. As the water got stale the nymph would ordinarily have climbed the side, and, protruding the rectum, have breathed the outer air. The slippery sides, however, forbade this, and the nymph died of asphyxia—breathing, I fear, maledictions on the stupidity of its captor.

The further point remains—which some reader can, perhaps, clear up—as to when the eggs of *Æ. cyanea* are hatched. The imagines appear late in June and during July, but ovipositing does not seem to begin until much later in the year, the end of August or beginning of September; yet, even so, as late as July 30, a nymph only measures 6½ mm., leading one to suppose at first sight that the eggs lie dormant during the winter and are hatched when the warm weather begins; but looking to the fact mentioned above that during the second winter the nymph scarcely grows at all, as evidenced by there being one moult only between the end of September and the beginning of May, we may perhaps suppose that the young nymphs are hatched in autumn, but that they grow but very little during the first winter.

But whether the young nymphs are hatched in the autumn or spring, it is clear that nearly two years are required to perfect the imago, viz., from the autumn of one

* KNOWLEDGE, October, 1900.

year when the eggs are laid to the next June or July *year*, when the perfect insect emerges, a period, say, of twenty-two months. The earliest appearance of *Æ. cyanea* known to the writer is June 25, and the latest date on which this variety has been seen flying about is November 2nd.

EUPHRATEAN DIVISIONS OF THE CIRCLE.

By ROBERT BROWN, JUNR., F.S.A.

THERE are in the British Museum three cuneiform Fragments, numbered respectively *Sm.* 162; 83-1-18, 608 and 81-7-27, 94, the two latter of which have not hitherto received the attention they well deserve. For brevity I will refer to these Fragments as *A*, *B* and *C*. Frag. *A* was discovered by George Smith 'in the palace of Sennacherib,' and was subsequently discussed with much ability by Messrs. Bosanquet and Sayce,[1] but not in connection with the general question of the reconstruction of the Euphratean Planisphere. So far as I am aware, Frags. *B* and *C* have not been studied except by myself. Frag. *A* is a portion of a sphere consisting of an outer and an inner circle, each divided into two parts. In the outer circle to the left is written the name of the 8th month of the year, and below it 'the Constellation Beast-of-death' (= *Lupus*). Below this is the number '140.' Below this, in the inner circle, is written 'the Constellation the Scorpion' (= *Scorpio*); and below this name is written the number '70.' In the outer circle to the right is written the name of the 9th month of the year, and below it 'the Constellation the Ancient Altar' (= *Ara*).[2] Below this is the number '120.' Below this, in the inner circle, is written 'the Constellation the Archer' (= *Sagittarius*); and below this is written the number '60.'

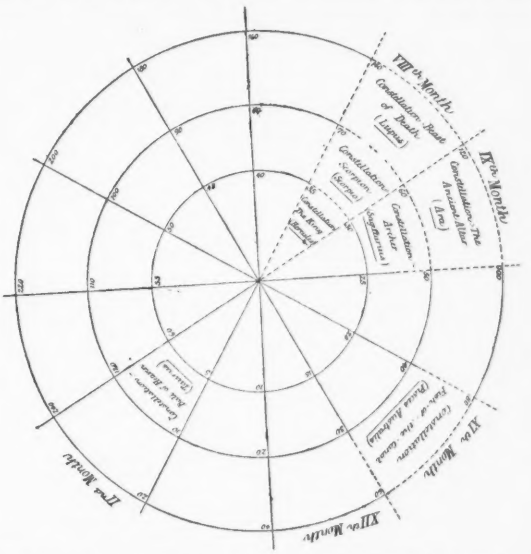
Frag. *B* is a portion of a sphere consisting of an outer and an inner circle. In the outer circle is written 'the Constellation the Scorpion,' and below this name is the number '70.' Below this, in the inner circle, is written 'the Constellation the King,' and below this name is written the number '35.' It will therefore be observed that the original Planisphere consisted of 3 circles, and that fortunately one segment of it has been preserved, viz.:—

Outer circle—Constellation	*Lupus.*	No. of degrees,	140.
Central „	„ *Scorpio.*	„	70.
Inner „	„ *Hercules.*[3]	„	35.

Of course the reader will notice the highly interesting fact that these constellations, alike in name and in position, are those of our own modern sphere; but, as I am now only speaking of divisions of the circle, I merely mention this in passing.

Frag. *C* is a portion of a sphere consisting of an outer circle divided into two parts. In the part to the left is written the name of the 11th month, and, below it, 'the Constellation Fish-of-the-Canal' (= *Piscis Australis*). Below this is the number '80.' In the part to the right is written part of the name of the 12th month. Thus in these Fragments we have the 8th month connected with 140°, the 9th with 120°, and the 11th with 80°. Hence, it is obvious that this outer circle was divided into 12 parts, one for each month; and, further, that each of the 12 parts was divided into 20°, whence the whole circle consisted of $12 \times 20 = 240°$. Lastly, as the 11th month was connected with 80°, a lower number than that connected with the 9th month, the 12th month must have been connected with 60°, the 1st with 40°, and the 2nd with 20°. Hence, at the time of the formation of this circle the Bull, the constellation of the 2nd month, led the year; and thus the arrangement of the circle was prior to B.C. 2540.

It is equally obvious that the central or zodiacal circle consisted of 12 divisions of 10° each, =120°; and that the inner circle consisted of 12 divisions of 5° each, = 60°. All this can be seen at a glance on reference to Fig. 1, and


VIIIth Month.
Constellation Beast of Death (Lupus)
IXth Month.
Constellation The Ancient Altar (Ara)
Constellation Scorpion (Scorpio)
Constellation Archer (Sagittarius)
Constellation Scorpion
Constellation King
Constellation Fish-of-the-Canal (Piscis Australis)
Constellation Fish-of-the-Canal (Piscis Australis)
Constellation The Great Altar (Ara)
Constellation Archer
Constellation Scorpion
Constellation King
Constellation Bull of Heaven
Constellation Bull of Heaven

was multiplied by 10, then the product was multiplied by 10, and then the result was multiplied by 10. The original number was thus triply intensified, and by this means totals were attained, not literally true, but merely expressions of vastness in the number of things or of years. It is necessary to say this much in illustration of the facts of the case. The central (zodiacal) circle was already, in the nature of things, connected with the number 12; and this mode of intensive expansion raised it to 120 divisions or degrees. I do not, however, assert that this principle is the only link between 10 and 12 in the matter. These circles thus showing a sexagesimal method, we find, as might be expected, the same principle confirmed by the cuneiform writing. The single wedge which represents '1' also stands for '60.' In Euphratean computation 60 is also the unexpressed denominator of a fraction; and we possess a tablet which 'gives a table of squares and cubes correctly calculated from 1 to 60.' The inhabitants of the Euphrates Valley further 'sub-divided the unit into 60 equal parts, and each of these parts into 60 further equal sub-divisions.'[4] And now, turning to a modern dictionary, we read:—

'*Sexagesimal arithmetic*, a method of computation by sixties, as that which is used in dividing minutes into seconds.—*Sexagesimal fractions*, fractions whose denominators proceed in the ratio of 60; the denominator is 60 or its multiple. These fractions are called also astronomical fractions, because formerly there were no others used in astronomical calculations. They are still retained in the divisions of the circle, and of time, where the degree or hour is divided into 60 minutes, the minutes into 60 seconds, and so on.'[5]

Thus do the thought and practice of early man in the Euphrates Valley still dominate the modern world. So small is the sphere of invention and of original mental effort; so much easier is it to beg, borrow or steal.

I pass on to notice two other Tablets, the first, *K.* 90, details the monthly progress of the moon through a circle of 480°; the second, Tab. 84-7-19, 273, details the same progress through a circle of 360°. *K.* 90 has been more or less treated of by Lenormant and by Messrs. Bosanquet and Sayce[6]; and the second Tab. by me in the *Proceedings* Soc. Bib. Archæol., Feb. 1900, where I give a copy of the remaining part of it. The calculations of the moon's progress in these two circles, although in some details at present unintelligible to me, are in perfect harmony. In the circle of 360° the figures are, as they should be in order to correspond, $\frac{1}{4}$th lower.

The two Tablets compare together thus:—

	Tablet *K* 90. (Circle 480°)	Tablet 84-7-19, 273. (Circle 360°)
	°	° ′
Lunar advance 1st day	5	3 45
" " 2nd "	5	3 45
" " 3rd "	10	7 30
" " 4th "	20	15
" " 5th "	40	30
	80	60 = $\frac{1}{6}$th of the month and circle.

Why the moon's apparent pace is thus varied is a question to which I invite the attention of astronomers. It does not concern the divisions of the circle. The first Tablet, written in Sumero-Akkadian, is of very high antiquity; the second formed part of the great astronomico-astrological work *The Illumination of Bêl*,[7] and therefore belongs to the third millenium B.C. A circle of 360° must also be connected with a year of 360 days, and in another Tablet[8] the year is stated to be composed of 12 months and 360 days. In these circles of 360° and 480° the numbers 6 and 60 are equally promiment as in the smaller circles.

I will next notice how the circle-numbers become cycle-numbers by the process of intensification already referred to. My late friend Geo. Bertin, in one of his lectures on Babylonian astronomy, stated that the Babylonians 'admitted the existence of a cosmical year. . . . This period was one of 360,000.' I have no original reference before me, but the statements of the Greek writers are in themselves sufficient to show that Bertin was right. The 360° of the circle multiplied by 10 = 3600, which × 10 = 36,000, which × 10 = 360,000, a total the result of the principle of triple intensification. The cosmical or divine year is thus vastly greater than the human year. According to this computation a divine day would = 1000 years; and this reminds us of the familiar statement in our own Sacred Books that, from the Divine standpoint, 'one day is as a thousand years.' When, therefore, Epigenês of Byzantion (tem. Augustus), who is stated to have studied in Babylônia, declared[9] that the Chaldæans had brick records of astronomical observations extending over a period of 720,000 years, these figures actually represent 2 cosmical years. The double of this, 1,440,000 or 4 cosmical years, is given by Simplikios[10] as the period of these observations. Bêrôsos and Kritodêmos of Kôs are said[11] to have put this term at 480,000 years, a number arrived at by treating the circle of 480° in a similar manner. Thus 480 × 10 × 10 × 10 = 480,000.

It is to be further noticed that the Euphratean ideas connected with cosmic periods appear to have influenced other Asiatic nations. Thus, the zodiacal circle of 120° × 10 × 10 = 12,000, reappears in the Iranian divine year of 12,000 ordinary years, and which gives 1000 years for each month and for each sign of the zodiac.[12] Thus, again, the Indian system of the Yugas or ages of the world presents many features which most forcibly remind us of the Euphratean scheme, and a Mahā-yuga is merely the Euphratean period of 432,000 years intensified by being multiplied by 10. Again, the Iranian stellar host is said to be 6,480,000 in number,[13] that is to say, 4,320,000 + 6000 × 360 (= 2,160,000), or 432,000 × 15, *i.e.*, the number of a Mahā-yuga and a half of years. All these numbers appear to be connected in origin, and are in no instance arbitrary, the larger amounts being intensifications of the smaller.

Lastly, through the kindness of M. Clermont-Ganneau, the eminent archæologist, I can conclude with a notice of a Palestinian circle of late times, which shows most strongly Euphratean influence, and in which by a very peculiar arrangement are expressed, directly or indirectly, circles of 12, 60, 120, 240 and 360 divisions or degrees. M. Clermont-Ganneau says:—

'Je me suis rappelé un curieux monument que je me

[4] Maspero, *Dawn of Civilization*, Eng. edit. p. 773.

[5] *Imperial Dict.* in voc. Sexagesimal.

[6] Vide Bezold, *Cat. of the Cun. Tabs. of the Kouyunjik Col. of the Brit. Mus.* i. 24.

[7] Hence the remark of Pliny concerning Belus, 'Inventor hic fuit sideralis scientiæ' (*Hist. Nat.* vi. 36).

[8] *W. A. I.* III. lii. No. 3, Rev. l. 6.

[9] Ap Pliny, *Hist. Nat.* vii. 36.

[10] Ad Aristot. *Peri Ouranou*, 475 B.

[11] Pliny, *Hist. Nat.* vii. 57.

[12] Vide *Bundahish*, xxxiv.

[13] *Bundahish*, ii. 5.

permets de vous signaler, et dont l'interpretation rationelle est encore à trouver. C'est un grand circle executé en mosaïque dans un pavement antique à El-Husn, dans la Palestine trans-jordanique. Il est d'époque relativement basse peut-être byzantine.'

After briefly describing this monument, and referring specially to the fact that the number 110 had evidently been designedly omitted, he adds: 'Je livre ce petit problém à votre sagacité.' I append a copy of the circle of El-Husn, and, following M. Clermont-Ganneau's example,

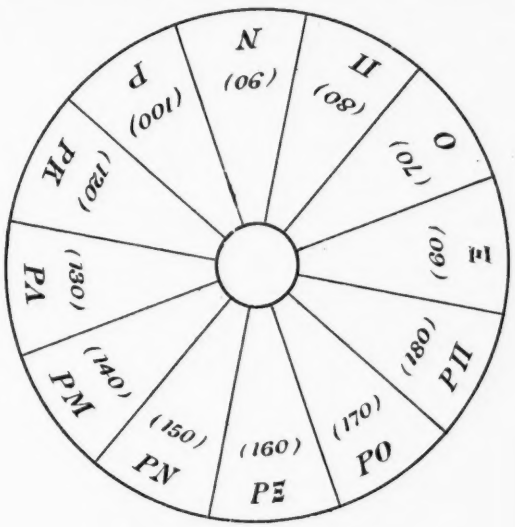


FIG. 2.—The Circle of El-Husn.

have inserted in brackets the numerical values of the Greek letters. As every division of a circle must, either expressly or by implication, begin with 1 and proceed 2, 3, etc., and as the numbers in this circle are not consecutive but range from 60 to 180, advancing by tens, except in the instance of 110, which is omitted, it is evident that two or more divisions of the circle are here shown in combination. In the abstract, a circle divided into 12 segments could be accommodated to the representation of 60, 120, 240, 360 or 480 parts (degrees), inasmuch as these several numbers are all divisible by 12. We have seen that two or more divisions of the circle must be shown by the Circle of El-Husn; and, as only 12 numbers were to be used, the problem before the circle-maker was how to express as many divisions of the circle as possible with these materials. The segments themselves showed the number 12, and the single number 60 sufficed to show by implication the division of the circle into 60°, commencing with Sec. PII—5°, PO—10°, and so on. A lower number than 60 could not have been used, (1) on account of economy in numbers, there being only altogether 12 numbers available to express all the ideas; and (2) because in a circle of 60° only, each segment must have been 5°, and such a segment would have prevented the harmonious expression of the other numerical circles. Hence the circle begins with 60°.

Now, had the numbers proceeded from 60 by increase of 10 without any omission, the total of the circle would have been 170°, an amount altogether inadmissible in any division of the circle. One decade (110) is therefore omitted, and at such a place as to bring 120 opposite 60, each on the line of one half of the circle. The 60, therefore, also represents the half of a circle of 120°, which latter is shown by commencing with PA—10°, PM—20°, and so on. Similarly, the 120 suggests the half of a circle of 240°, and the 180, which is also arranged to fall at the half circle, the half of a circle of 360°. Thus, the circle of El-Husn, by the use of only 12 numbers, expresses circles of 12, 60, 120, 240 and 360 degrees.

Such, then, are the Euphratean divisions of the circle which have come down to us, and thus do Euphratean concepts and principles connected with it still rule our world of to-day.

ASTRONOMY WITHOUT A TELESCOPE.

By E. WALTER MAUNDER, F.R.A.S.

XVII.—STARS BY DAYLIGHT; AND THE SUM OF STARLIGHT.

ARE the stars visible to ordinary sight in the daytime? There is a widespread tradition that they are; that if an observer places himself at the bottom of any deep shaft—as of a mine, a well, or a factory chimney—which may shut off scattered light and reduce the area of sky illumination acting on the retina, he will be able to discern the brighter stars without difficulty. The tradition is one of a respectable antiquity, for Aristotle refers to persons seeing stars in daylight when looking out from caverns or subterranean reservoirs, and Pliny ascribes to deep wells a similar power of rendering visible the stars the light of which would otherwise be lost in the overpowering splendour of the solar rays.

The tradition, well founded or not, has often been adopted for literary effect. It seems almost sacrilegious to hint that no star known to astronomers could have shone down unceasingly upon poor Stephen Blackpool during his seven days and nights of agony at the bottom of the Old Hell Shaft; that at best he could only have caught a glimpse of it for a few minutes in each twenty-four hours as it passed across the zenith. Dickens indeed does not absolutely say that Stephen watched the star by daylight. It is only a natural inference from his description; but Kipling adopts the tradition in its extremest form when he writes of:—

"The gorge that shows the stars at noonday clear."

But is the tradition true? Of course everyone knows that Venus from time to time may be seen even at high noon; but then Venus at her brightest is many times over brighter than Sirius. Then, again, the assistance of a telescope enables the brighter stars to be discerned at mid-day; but the telescope not only directs the eye and greatly limits the area from which the skylight reaches the observer, but it enormously increases the brightness of the star relative to that sky illumination. The naked-eye observation of true stars in full sunlight stands in quite a different category.

Humboldt, who was much interested in the question, repeatedly tried the experiment in mines, both in Siberia and in America, and not only failed himself ever to detect a star, but never came across anyone who had succeeded. Much more recently an American astronomer set up a tube for the express purpose of seeing the Pleiades by daylight, also with no effect. It has been supposed that Flamsteed, the first Astronomer Royal, sank a well at Greenwich Observatory for the purpose of observing Gamma Draconis, the zenith star of Greenwich, in this manner. The existence of the well is undoubted, though Sir George Airy, the late Astronomer Royal, was unable to find it, but Flamsteed marks it on more than one of his plans of the Observatory, and there is a drawing extant of the well itself, showing the spiral staircase that ran down it. But its purpose seems to have been, not to have furnished the

means of observing the star with the naked eye, but to enable the observer to measure as accurately as possible the distance of the star from the true zenith at the moment of transit.

Sir John Herschel mentions a case, which he considers as satisfactory evidence, of an optician who stated that the earliest circumstance that drew his attention to astronomy "was the regular appearance at a certain hour for several successive days, of a considerable star through the shaft of a chimney." This, it will be noticed, is second-hand evidence. I have never been able to obtain evidence even so direct as this myself, though I have met several persons who felt quite confident that they had seen stars by daylight on looking up the shaft of a mine, or that "some one had told them he had done so."

But the value of such indefinite statements is *nil*. I have met evidence more direct and explicit in support of that favourite legend due to the fertile imagination of the Emperor Jahangir, of the Indian juggler who threw a rope into the air and climbed up it, to disappear at its top into space—a legend which still makes periodic reappearances, and finds not a few devout believers. But direct, first-hand, scientific testimony of an observer who has been enabled by the use of a shaft to detect stars with the naked eye at midday is still to seek. By scientific testimony, I mean the record of the day, hour and minute when the star was seen, the latitude of the place, the depth of the shaft, the breadth of its mouth—the numerical elements, in a word, which are necessary to give value to the observations. There must be not a few of the many who take an interest in astronomy to whom the means for making such an observation are available, and who, if they would take the trouble, could report, "I have seen such a star at such a time," or, "I have watched for such a star at the time of its transit across the zenith on so many occasions, when the sky was clear, and could see nothing." Such observations would set the question at rest whichever way they tended; but what are wanted, here as elsewhere, are definite observations, carefully made, fully and systematically recorded, not vague, second-hand impressions which are perfectly valueless as evidence.

Whether or no the use of a shaft to diminish the effect of sky illumination, and so to render the stars visible by daylight is practicable, it suggests a method for dealing with what Prof. Newcomb in a recent paper has justly described "as among the most important fundamental constants of astrophysics," namely, the value of the total light of all the stars. In the paper* alluded to, Prof. Newcomb points out that the "total amount of light received from all the stars may serve as a control on theories on the structure of the universe, because the amount of light resulting from any theory should agree with the observed amount. It is also a quantity which we must regard as remaining constant from age to age." Yet, strangely enough, few if any attempts have been made to determine it. One of these was made by Mr. Gavin J. Burns,† his method being to compare the brightness of the spurious disc of a star seen out of focus in a telescope with the light of the sky. The eyepiece of the telescope was pushed in and out until the brightness of the spurious disc seemed to correspond with that of the sky. Prof. Newcomb, two years later, adopted several plans, his purpose being a twofold one—first to determine the relative brightness of different portions of the sky, and next to express the brightnesses of given units of surfaces in terms of starlight, from whence in turn the brightness of the whole heavens in terms of starlight may be inferred.

* *Astrophysical Journal*, December, 1901.
† *Journal Brit. Ass. Asc.*, Vol. XII., p. 212.

Prof. Newcomb's first plan was to use a small tube, the length of which he could easily vary, the ends of the tube being covered with caps having apertures of varying diameters, and to measure therewith the smallest area of sky which was certainly visible to him. A second method was by means of small mirrors arranged so as to enable different regions of the sky to be compared directly. Roughly speaking, the Galaxy appeared, surface for surface, about twice as bright as the sky outside it.

For the determination of the brightness of different areas in terms of starlight a concave lens was used, so as to spread out the image of the star into a disc, and the brightness of the expanded image was cut down by means of an absorbing glass to that of the sky. The results appeared to point to a value for the total starlight of over 600 to 800 stars of magnitude 0, whilst Mr. Gavin Burns, by different methods, fixed the value at about 400 stars for one hemisphere, or 800 for the entire heavens. Both results, though more accordant than might have been expected, can only be regarded as first approximations, and there is abundant room for many other observers to follow these pioneers, and supplement their work.

One method for comparing the light of the sky in two different regions would be by means of some such simple apparatus as the following:—A tube, bent at right angles, should be fitted at the angle with a piece of card placed at 45° to either arm. The card should be painted a dead black all except a white cross in the centre. The observer should look down one arm, through a diaphragm about $\frac{1}{8}$ inch in diameter, and view the card, which would be illuminated by the light coming down the other arm, and the opening of which would be directed to some known region in the sky. This opening should be provided with a series of caps having apertures of different diameter, and the arm itself should be fitted with a draw tube, so that both the size of the opening and its distance from the card might be varied at will. The observer, having carefully set the tube in some given direction, would move the draw tube in or out, or vary the caps over the aperture, until the white cross on the cardboard in the angle could just be certainly discerned. The aperture, the length of the draw tube, and the part of the sky to which it is directed, must then be carefully recorded.

The rough altazimuth, described in the chapter on "Observations of the Sun,"* would prove a suitable mount for such an instrument. If used for this purpose its circles must be read, whilst, of course, the time of the observation should be taken, and the state of the sky noted. Necessarily, observations of this kind are only possible at stations far from the glare of towns, and on moonless nights of special clearness.

The observer might well begin his work with some such device as this, but in a field so nearly new there would be full scope for his best ingenuity and contrivance in improving on this beginning, and in arranging for better and exacter methods for dealing with the noble problem he had undertaken.

It must be noted that the result of these observations will give the sum of starlight + any other general source of illumination which may be present. It must be assumed that the observer is working far from the influence of any artificial lights, and that so far as he can ascertain there is absolutely no cloud or mist in the sky. But there still remains the question whether the general illumination of the sky does not vary from time to time. Thus, two observers of the very first rank, Mr. Denning and Mr. Backhouse, have recorded that in August, 1880, the sky was unusually light. It is clear that the sum total of

* KNOWLEDGE, 1900, June.

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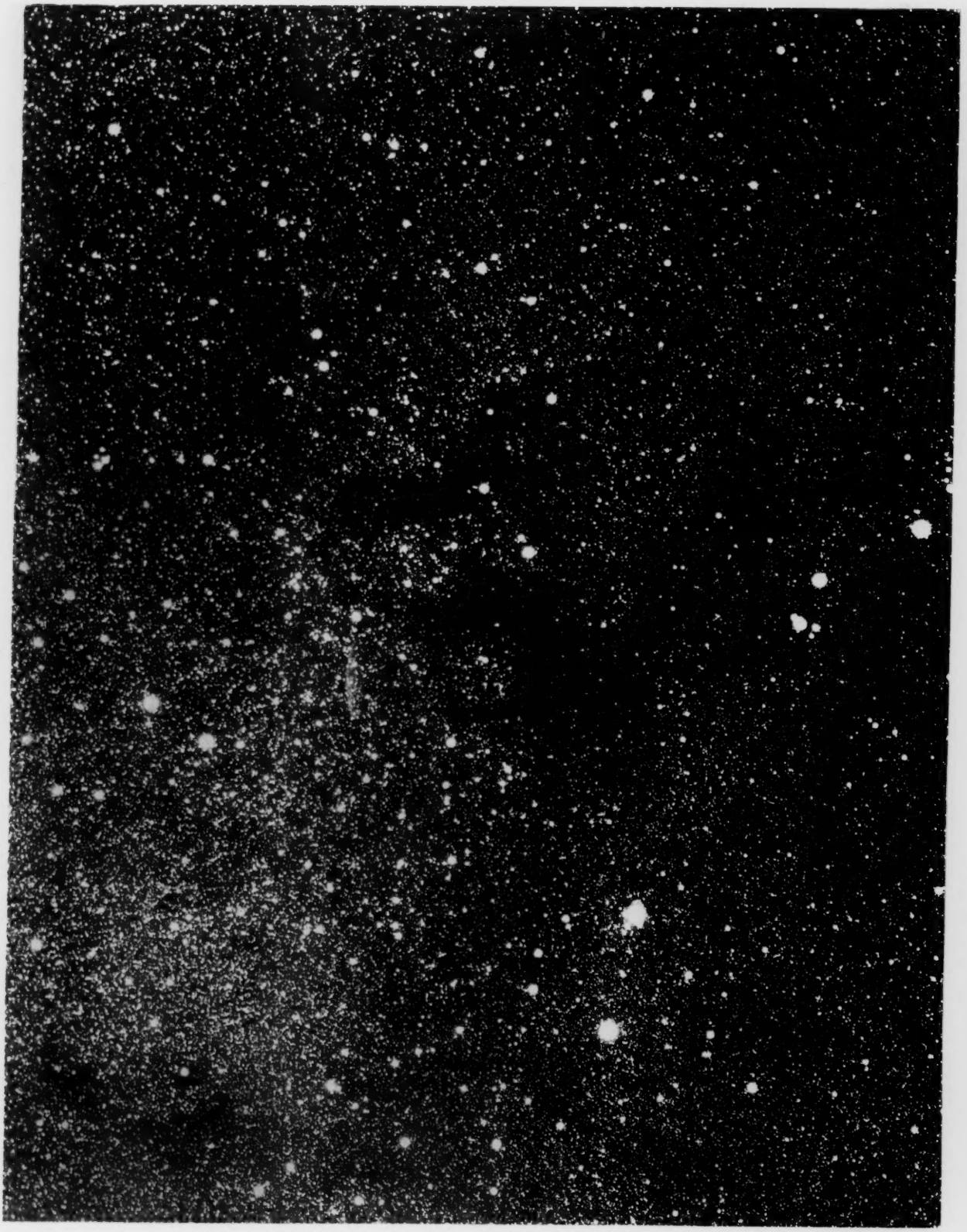
SOUTH.



NORTH.

THE "TRIPLE CAVE" IN AQUILA.

Photographed at Heidelberg, by Dr. Max Wolf, with the Brashear 16 inch portrait lens, on July 19th, 1901. Exposure, 3h. 45m.

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starlight cannot vary from time to time, and if the light of the sky is different on one occasion from that which it is on another, allowance, of course, being made for any annual variation, due to the Milky Way or some of the brighter constellations being in an especially favourable position, then this variation in luminosity must be due to some cause other than starlight. Over and above, therefore, the two very important researches (*a*) of the relative brightness of different portions of the heavens, and (*b*) of the total sum of starlight, there will come the question as to whether there is in addition any variable source of luminosity, and, if so, what are its nature and origin, and the laws and causes of its changes.

THE "TRIPLE CAVE" IN AQUILA.

By Dr. MAX WOLF.

THE writer discovered these very interesting dark structures in the Milky Way in Aquila on the 12th of July, 1891, using a Kranz 5-inch photographic doublet. Their discovery was published for the first time at the meeting of the Astronomische Gesellschaft at Munich in 1892. The broadest arm of the dark structure appears as if it were the nearest, and the smallest arm as if it were the furthest from the observer, so that it would seem to give a perspective view into space of the heavens in the Milky Way. But this is probably a mere illusion.

The accompanying plate is a reproduction of part of the original negative made with the worse of the two Brashear 16-inch portrait lenses. The plate taken with the better lens shows a defect in the centre of the structure, and is therefore not suitable for reproduction. A bubble in the glass of the negative from which the present reproduction is taken shows itself as a slight defect, but does not interfere with the representation of the dark structure, and the photograph seems therefore good enough for publication.

The broadest of the three "caves" is the most southerly. The co-ordinates of the middle "cave" are—

R.A. = 19h. 33m. Dec. = + 10° 35′ (1855·0).

The plates were exposed on July 19, 1901, for three and three-quarter hours. Scale, one degree equals about seven centimetres.

Heidelberg.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

VISIBILITY OF THE CRESCENT OF VENUS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—I would like to add a word to the discussion raised by Mr. Maunder's interesting remarks on the visibility of Venus. I was stationed for some time in the remarkably fine air of Darjeeling, at an elevation of about 8000 feet. On any clear night when the Pleiades were high up I could see eleven stars without difficulty; I have glimpsed twelve. The dividing of ϵ Lyræ in that air was easy, though it is generally not so in England. And whenever Venus was fairly high up I could almost certainly pick her up within 5 minutes with the unaided eye, knowing only the general direction in which to look, and not using my equatorial as a guide. In this way I have seen her when crescented very near to overhead, and I entirely failed to trace the least vestige of her true shape. With a magnification of 3 the crescent was visible, but no more.

As to Jupiter's satellites, I cannot help thinking that, in a perfectly still clear air, with no glare, the outer area would be visible without optical aid if a fine wire were fixed up and used as an occulting bar—but I have not tried this.

J. W. MEARES.

Writers' Buildings, Calcutta.

THE SUPPOSED DISCOVERY OF ALUMINIUM 2000 YEARS AGO.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—The following paragraph appeared in "Echoes of Science" in the *Globe* of August 19th, 1898:—

> "The first discoverer of aluminium had the reward of genius. Pliny tells us that in the reign of Tiberius (41 B.C. to 37 A.D.) a worker in metals presented a beautiful metal cup resembling silver, but lighter, to the Emperor, who questioned him, and learned that he had extracted the new metal from clay. The secret, he said, was known but to himself and the gods. The sage Tiberius, reflecting that if this metal could be made from earth it would lower the price of silver and gold, decapitated the artificer in order that his secret might remain with the gods, and so deprived the world of a most useful metal for eighteen centuries."

It would interest many readers of KNOWLEDGE if some student of Pliny would state where in his works the account is to be found, and furnish a translation thereof.

That the metal of which the cup was formed was really aluminium appears possible from four circumstances:—(1) It was obtained from clay; (2) it resembled silver; (3) it was lighter than silver; (4) it was capable of being wrought into a vessel.

The question naturally occurs, How did the metallurgist of the first century obtain a metal, which in the twentieth century can only be extracted by processes totally unknown to the ancients, and which it is inconceivable that any individual worker among them could have accidentally hit upon? Modern methods of procuring aluminium are: (1) Chemical, involving the use of sodium or potassium; and (2) electrical. The contemporary of Tiberius cannot have knowingly isolated sodium or potassium, and then applied it to separate aluminium, though it is possible that sodium or potassium may have been liberated from some ingredient of a mixture in his retort or crucible, only to oust aluminium from some other ingredient. That his process was electrical is quite out of the question.

If Pliny's account actually refers to aluminium there must be some method of separating it which modern chemists have failed to light on, but which lay not very far outside of the range of ancient metallurgical knowledge. Cannot it be rediscovered by some chemist possessing a wide knowledge of the science, and who is at the same time well acquainted with the methods (many of them forgotten) adopted by ancient and mediæval workers? Such a process would probably go very far towards cheapening that most useful metal.

3rd July, 1902. JOHN T. KEMP.

British Ornithological Notes.

Conducted by W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U.

BIRDS IN CAPTIVITY.—The *Zoologist* for July contains a really valuable and extremely interesting article by Dr. A. G. Butler, in which he recounts his avicultural experiences for the past twenty years. He surveys in turn the postures, bowings, and dances of birds when courting, their songs, nest-building, sexual characters, and habits in confinement. It is difficult, from the mass of information which Dr. Butler has brought together, to select items for special comment, but his remarks on the precocious development of some birds seem particularly interesting. Thus he writes: "Some of the little Ploceid

Finches (such as *Amadina fasciata* and *Tæniopygia castanotis*) are in full adult plumage, and ready to breed when about six to eight weeks old; thus examples of the former, which left the nest in September, were breeding in October; and it is not uncommon for Zebra Finches (*T. castanotis*) to build and lay when eight weeks old."

THE RACKET-TAILED PARROT.—The *Field*, July 12th, contains some interesting observations on the Racket-tailed Parrot (*Prioniturus platurus*), recently purchased by the Zoological Society. This is not only the first specimen of its kind acquired by the Society, but appears to be the first ever brought alive to Europe. If this bird lives through the next moult it will be interesting to watch whether the peculiar racket-shaped middle tail feathers, from which the bird takes its name, are natural growths, or artificially produced like the similar tail feathers of the Motmot.

WHITE STORK NESTING IN KEW GARDENS.—The *Field*, August 2nd, contains a graphic description by Dr. Günther of the successful breeding of the White Stork, during the spring of this year, in the Royal Gardens at Kew. Twice before the now triumphant pair have essayed to rear a family, but their attempts proved abortive. This year, however, they succeeded. A low platform of sticks was erected between two elms, near the lake, and on this the birds built a nest of dried twigs. On the 14th April the first egg was laid, five days later a second was deposited, and this was followed by three others on alternate days. Of these five eggs, two were addled, and of the three chicks hatched but one now remains. Dr. Günther, in his article, draws special attention to two extremely interesting points. In the first place he writes that the young do not appear to have been fed in the orthodox fashion, inasmuch as according to the ornithological records the adults insert the beak in that of the nestling, and passes from the stomach a meal of half-digested food. According to the observations of the keeper the food was deposited on the edge of the nest, and taken by the young without the assistance of the parents. Secondly, he remarks that the rate of growth was at first very slow, at a month old the nestling was not larger than a duckling of the same age, and still downy; after this time growth was rapid.

White-fronted Goose Nesting in Captivity.—Mr. W. H. St. Quinton writes to the *Field* (July 19th) pointing out that Mr. Frohawk's letter of July 5th, and referred to in our August issue, is slightly incorrect, in so far as he states that the nesting of the White-fronted Goose in confinement at Blackheath constitutes the only authenticated instance. Mr. St. Quinton has a pair of these birds which successfully hatched out four goslings in 1900, and this year she again hatched four young.

Interesting Arrivals at the Zoo.—Three young Secretary Birds from Kordofan, presented by Col. Mahon, have just been placed in the eastern aviary. At present they are but in indifferent plumage, but it is to be hoped they will rapidly improve.

MR. HARRY WITHERBY *having now returned from Persia, all communications with reference to this column should be addressed to him at the Office of* KNOWLEDGE, 326, *High Holborn, London.*

NOTES

BOTANICAL.—*Byblis gigantea*, a plant of considerable interest from Western Australia, is figured in the July number of the *Botanical Magazine*. In Bentham & Hooker's *Genera Plantarum* the genus is referred to the Droseraceæ, from which it differs in several important characters, including the simple style and the two-celled ovary. The late Mr. Bentham, in the *Flora Australiensis*, points out its resemblance to *Cheiranthera*, an Australian genus of Pittosporaceæ; and Mr. F. X. Lang, in a long paper published in *Flora* for 1901, states that *Byblis* approaches most nearly *Polypompholyx* in Lentibulariaceæ. He notes that its glands do not agree in structure with those of Droseraceæ, but do closely with those of some Lentibulariaceæ; also that the corolla of *Byblis* is gamopetalous. He attaches much importance to this character, but Sir J. D. Hooker finds that the petals are obscurely coherent at the very base, and even there only in a young state. The plant he considers requires further investigation, and meanwhile prefers to leave the question as to its order unsettled.

Das Pflanzenreich, the great work now appearing under the editorship of Dr. Engler, of Berlin, has just reached the eleventh part, which consists of a monograph of the Marantaceæ by Prof. K. Schumann. Among the other orders already elaborated may be mentioned Aceraceæ, Monimiaceæ, Symplocaceæ, Myrsinaceæ, and Tropæolaceæ. The monograph of the Myrsinaceæ, by Prof. Mez, forms a volume of 437 pages. The need for such a work as this has been very pressing for many years, as the best work of the kind now in use—De Candolle's *Prodromus*—is considerably behind the times. By Dr. Engler himself, and under his direction, numerous important contributions have been made during the last ten years to our knowledge of the Flora of Tropical Africa. The *Monographieen Afrikanischen Pflanzen-Familien und-Gattungen* is a finely illustrated quarto, of which five parts have appeared, the last dealing with the Anonaceæ. If continued in its present form this work will almost rival in magnitude the *Flora Brasiliensis*. Engler's *Botanische Jahrbücher* contains in nearly every part some important paper on African botany. Belgian botanists are also devoting their attention to Tropical African plants, while in this country the *Flora of Tropical Africa*, edited by Sir W. T. Thiselton-Dyer, is making steady progress.—S. A. S.

ZOOLOGICAL.—The Zoological Society's menagerie has recently been enriched by the addition of a living example of the proboscis-monkey of Borneo, the first of its kind ever received in the gardens. Unfortunately the specimen, which is a male, is immature, so that it does not show the great development of the nose characteristic of the adults of that sex. Should it survive and grow to maturity, it will serve to correct the ordinary idea of the form of that appendage. For it is a somewhat curious coincidence that Dr. Jentink, in the *Notes of the Leyden Museum* for July, has just published a photograph taken from a living adult male of this monkey, which shows that the nose, in place of being narrow and projecting straight forwards, is spatulate and bent downwards so as to conceal the mouth in a full-face view.

Certain structures in the brain of marsupials form the subject of an important paper contributed by Prof. G. E. Smith to the *Proceedings* of the Royal Society. These serve to show that the "diprotodont" members of that group, such as kangaroos, phalangers, and wombats, differ markedly from their carnivorous "polyprotodont" relatives in this respect. The author also concludes that the full development of the so-called corpus callosum in the brain of the placental mammals has given them an advantage quite sufficient to account for the dominant position they have acquired in the world's fauna.

Two interesting new types of marine invertebrates, each known solely by a more or less damaged example, have recently been made known. The one is a swimming type of zoophyte, or hydroid polyp, from New Zealand, described by Dr. Dendy under the name of *Pelagohydra mirabilis* in the *Quarterly Journal of Microscopical Science*. For the description of the second, a new form of crinoid, or "stone-lily," naturalists are indebted to Messrs. Koehler and Bather. This form, which was dredged off the Canaries (not, as stated in the text, off the Azores) by the Prince of Monaco, is described in the *Mem. Soc. Zool. France* as *Gephyrocrinus grimaldi*. Both forms constitute new generic types.

In a paper contributed to the *Geological Magazine*, Dr. Andrews continues his account of the wonderful Tertiary vertebrate fauna of the Fayum district of Egypt. In that instalment he describes the skull of a "sea-cow," or sirenian, which he regards as generically distinct from all hitherto known types, and proposes to call *Eosiren libyca*; and likewise two additional forms of the Proboscidean genus *Moeritherium*.

Professor Noack, of Brunswick, has published in the *Zoologischer Anzeiger* for February last an account of the Mongolian wild horse (*Equus przevalskii*), based on the specimens obtained by Herr C. Hagenbeck, many of which are now living in the Duke of Bedford's park at Woburn. It appears that *taka* is the Mongolian name of these animals, which inhabit the district east of the Garchun oäsis, as well as the Zungarian desert, and the neighbouring mountains to a height of 7500 feet. They are now found in herds of fully a thousand strong, each led by an old stallion. Certain individual differences of colour noticeable in the herd brought to Europe Prof. Noack attributes to the different localities whence the specimens were obtained. The individuals from the open desert he describes as light greyish yellow fawn in colour, while those from the lower mountains are light yellowish brown, and those from higher elevations, dark yellowish rufous. In the lightest coloured individuals the muzzle is white, in the darker ones bright yellow, and in the darkest rusty yellow. Prof. Noack is quite convinced of the specific distinctness of the Mongolian horse, alike from the now extinct tarpan of the Kirghiz steppes, and the domesticated or half-wild horses of Mongolia. He adds that no skins or skeletons of the tarpan, which was exterminated in 1876, appear to have been preserved in any museum.

In the same journal, Professor Noack describes as new a stag from Zungaria, of which specimens were brought to Europe by Herr Hagenbeck's expedition, under the name of *Cervus wachei*. He describes the antlers as wapiti-like at the base, but at the summit approximating to those of the rusine or rucervine groups. In the absence of figures it is difficult to form an opinion as to the affinities of this deer.

The bighorn sheep shot by Mr. J. Talbot Clifton in North Siberia, to which allusion has been previously made in these columns, has been presented by that gentleman to the Natural History Museum, where it is now exhibited in the pavilion at the end of the lower Mammal Gallery. Visitors to that part of the gallery will not fail to notice that the magnificent series of bison and buffaloes occupying the large case at the west end have been mounted upon artificial groundwork, with the very best results so far as appearances and general effect are concerned.

A theory has long been current that the skeletons of *Iguanodon* from the Wealden formation of Bernissart, which constitute one of the chief attractions of the Brussels Museum, were deposited in a narrow gorge cut through Carboniferous strata and subsequently filled up with materials of Wealden age. This theory M. de Pauw, the clever articulator of the Museum, demonstrates (*Mem. Soc. Hainaut*, May, 1902) to be founded on a misconception. The iguanodons, as a matter of fact, lived on the borders of a lake, where in due course they died and their bodies became buried in the mud. It is generally considered that these reptiles always walked in the upright position, but M. de Pauw believes that they went frequently on all fours, and commonly assumed this attitude when leaving the lake.

A prehistoric drawing on a slab of limestone found near Schaffhausen, together with fossil remains from the same locality, are regarded by Prof. T. Studer (*Denks. Schweiz. Nat. Ges.*, Vol. XXV.) as sufficient to indicate the existence during the Pleistocene period of the Kirghiz wild ass, or chiggetai, in Switzerland.

Notices of Books.

"STUDIES IN HETEROGENESIS." By Dr. H. Charlton Bastian, F.R.S. Part II. Pp. 63—147 and xvii. Plates VI.—XI. (Williams & Norgate.) 7s. 6d.—Dr. Bastian is very candid as to the reception which the scientific world has given to his observations. The Royal Society of London, the Academies of Science at Paris and Berlin, and the Accademia dei Lincei of Rome will have none of them; so in the memoir before us, and the one which was published a few months ago, a statement of the case for heterogenesis is placed before students of biological science independently of scientific societies. In this position Dr. Bastian should be content to leave his heterodox conclusions as to the production of several kinds of organisms from one cell substance. He can scarcely expect zoologists to accept his interpretations, whatever they may think of his observations. He announces that he has "witnessed on very many occasions the stages of this remarkable transformation of the contents of a Rotifer's egg into a Ciliated Infusorium." To apply strictly scientific tests to each stage of observation involved in this conclusion would take months of investigation, and there are so many *à priori* reasons against its validity, that zoologists are justified in hesitating to accept Dr. Bastian's views until they have the opportunity to make their own observations and analyse his methods of procedure. There are still people who believe the earth is shaped like a Cheddar cheese, and they can bring forward evidence apparently in support of this theory. Dr. Bastian would find it difficult to state observations which completely dispose of their conclusions; and biologists are in much the same position in relation to his work. Or shall we compare him to a Galileo who has seen new worlds and desires others to look for themselves and be convinced of their reality?

"PLANT RELATIONS: A FIRST BOOK OF BOTANY." By John M. Coulter, A.M., PH.D. Second Edition. Revised. Pp. ix. and 266; and "PLANT STRUCTURES: A SECOND BOOK OF BOTANY." By the same author. Pp. ix. and 348. Both illustrated. (London: Hirschfeld Bros. 1902.) Each 6s. net.—The number of botanical text-books published in this country and America within the last few years must almost create some perplexity in the minds of students and teachers in selecting one most suitable for their purpose. Professor Coulter, who has had considerable experience as a teacher, and has written treatises on nearly every branch of botany, might be expected to be especially well equipped for the production of a text-book, and no doubt can exist as to the excellence of those now under our notice. Lucidly written, beautifully and copiously illustrated, the works cannot fail to interest and teach all who may use them, and it is with pleasure that we recommend both volumes to our readers. The first edition of "Plant Relations" was issued in 1899 in New York. The present one, though practically the same in the first eleven chapters, has been much modified in the latter part dealing with plant societies, both in text and illustrations, as "this has been made necessary by the recent rapid development of the subject, by a larger field experience, and by the availability of more suitable illustrations." "Plant Structures," which forms the second part of the work, was originally published in 1899, and the copy before us, dated 1902, is, we presume, merely a reprint of the American edition. "Plant Relations" is devoted to the study of the natural history or, as it is often termed, the

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ecology of plants. It is calculated to represent work for a half year, and is independent of the second book, which deals chiefly with plant morphology, and represents work for another half year. The fourteen chapters of the first book begin with an introduction. Then follow chapters on foliage leaves, shoots, roots, etc. Chapter 7 deals wholly with flowers and insects, and chapter 9 with "the struggle for existence." The final portion of the book treats of plant societies (Hydrophytes, Xerophytes, and Mesophytes) which are determined by the conditions of water supply. Besides the morphology of plants, the second book includes a general review of the large systematic groups beginning with the Thallophytes and concluding with the Compositæ, proceeding according to the arrangement of Engler and Prantl. This part contains a useful glossary and each is provided with a good index. Professor Coulter published a work in 1901, under the title of "Plant Studies," reviewed in KNOWLEDGE, 1901, p. 233, which is based on the works before us. His books, by reason of their accuracy, freshness and originality, will doubtlessly be widely used by American students of botany, and only need to be known to become popular in this country.

"MOSQUITO BRIGADES AND HOW TO ORGANIZE THEM." By Ronald Ross, F.R.C.S. (Philip & Son.) 3s. net. Few modern discoveries have appealed more strongly to the popular mind than that of the part taken by mosquitoes in spreading disease, and Major Ross's leading share in this discovery is known to all. In this handy little volume he shows how practical use can be made of the knowledge that we have gained by organizing brigades of men whose work shall be the extermination as far as possible of mosquitoes in the neighbourhood of populous tropical cities and settlements. The chief means suggested is to drain stagnant pools and ditches in which Anopheles breeds, and to clear away useless vessels of dirty-water which harbour the larvæ of Culex. This is a surer means of destruction than to cut the grubs off from the air supply by the application of a film of oil to the water surface. The book is essentially practical, and the record of what has been done under the author's leadership in Sierra Leone shows how much benefit may be expected if the subject be earnestly taken up by those in authority. When we consider that the parasite causing malarial fever is absolutely dependent for its continuance on mosquitoes of the genus Anopheles, and those causing yellow fever and elephantiasis on mosquitoes of the genus Culex, and that both these genera depend on stagnant water as a breeding-place for their larvæ, we cannot fail to subscribe to Major Ross's "first law of tropical sanitation, namely, *no stagnant water*." These "Mosquito Brigades" are proposed as voluntary organizations where the local authorities will not take the matter up. Unfortunately, Major Ross has to complain of the apathy of those in authority, and their frequent unwillingness to carry out the practical measures of prevention, so surely indicated by his researches. In this connection one remark of his may be applied to other things besides mosquito-extermination:—"It is disgraceful that in scientific matters concerned with the life and death of thousands, scientific men should be so absolutely subordinated to unscientific men."

"REPORT OF S. P. LANGLEY, SECRETARY OF THE SMITHSONIAN INSTITUTION, FOR THE YEAR ENDING JUNE 30TH, 1901." Pp. 140. (Washington. 1901.)—In this report Dr. Langley surveys the work done between June, 1900, and June, 1901, by the United States National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, and the Astrophysical Observatory—all these departments being under the direction of the Smithsonian Institution. He gives a general account of the affairs of the Institution and its bureaus, and this is supplemented by more detailed statements by the officers in direct charge of the different branches of the work. The field surveyed is so vast that only a brief reference to some parts of it is here possible. A number of investigations are being carried on in connection with the Hodgkins Fund, among them being the relation between light and electricity, by Dr. V. Schumann; air currents at various altitudes, by Dr. A. Lawrence Rotch; and a study of air currents in relation to mechanical flight and ventilation, by means of chrono-photography, by Dr. Marey. In the National Museum Dr. Langley has had a children's room arranged. The room itself has been made attractive by a careful choice of colour and design in the decoration of the walls and ceilings, embodying illustrations of the life of animals and plants. The objects displayed in the room include cages of living birds, aquaria with living fishes, and cases filled with those things which interest children even of larger growth. The National Zoological Park was established with the view of preserving rare American animals from extinction by keeping them so far as possible in their natural surroundings; but though the aim is admirable, the funds granted by Congress are insufficient to carry out the scheme. In the report on the Astrophysical Observatory, reference is made to the eclipse expedition to Sumatra in May, 1901, which, unfortunately was unsuccessful on account of bad weather during the eclipse. Referring to the bolometer, Dr. Langley says that his instrument is now so sensitive that it will recognise a change of temperature less than one one-hundred-millionth of a degree. Many other subjects are mentioned, but we are unable to refer to them, though in common with other workers in the realm of nature we highly appreciate the contributions to knowledge made under the direction of the Smithsonian Institution, and the generous spirit with which the results are made available to the whole scientific world.

"ESSAYS IN HISTORICAL CHEMISTRY." By Dr. T. E. Thorpe, C.B., F.R.S. Pp. xii., 582. (Macmillan.) 12s. net.—There are certain books which should be found in the library of every institution where science is taught, and this is one of them. Nothing is more inspiring to a student of science than a luminous account of the works of investigators who have contributed to the sum of natural knowledge; and we have in the present volume a survey of this character, in so far as it concerns chemistry. Dr. Thorpe has a facile pen, and a keen sense for interesting personal characteristics and essential points of progress. His essays represent presidential addresses, lectures, and contributions to various publications, and each one is a pleasure to read. The pioneers whose works are described are Boyle, Priestley, Scheele, Cavendish, Watt, Lavoisier, Faraday, Graham, Wöhler, Dumas, Kopp, Victor Meyer, Mendeléeff, and Cannizarro, while others are dealt with in accounts of progress made during various epochs. In this series of sketches we have the fundamental facts concerning the development of chemical science presented in their most interesting form; the masters are seen, as it were, in their laboratories, and the influence of each upon the progress of chemistry can be discerned. It is an inspiring story—this record of work carried on with the sole desire to obtain new knowledge of chemical compounds and changes—and the student of science who reads it should be proud that he is following in the path of those who have worked with so noble a purpose. Emoluments may be meagre and honours few, as judged by the world's standards, but a life devoted to the investigation of natural processes of any kind is sufficient unto itself.

"A LABORATORY COURSE IN PLANT PHYSIOLOGY, ESPECIALLY AS A BASIS FOR ECOLOGY." By W. F. Ganong, PH.D. (New York: Holt. Sold in England by G. Bell & Sons.) Price 5s.—This is essentially a book for the teacher and advanced student of botany. Prof. Ganong's "Teaching Botanist" appeared in 1899, and was received with well-merited favour. That work was intended for the student of the first year, being a synopsis of the subject to those who follow it no farther, and a foundation for higher work to those who do. The second and third years should be devoted, according to Prof. Ganong, to courses in morphology with correlated ecology, cellular anatomy, particularly of the higher plants, with cytology and embryology, while the present work, "a practicum in physiology," should guide the fourth year's course. To get through it in one year it is requisite that the student should work each week about eight hours in the laboratory, with one lecture and one hour devoted to criticism of experiments and comparison of results. The first part of the book contains a description of the method to be followed and of the equipment necessary, and is directed chiefly to the teacher. Part II. is an Outline of a Course in Experimental Plant Physiology, made up of two divisions—(1) The Structure and Properties of Protoplasm, and (2) The Physiological Operations of Plants. The interrogative form is adopted, and following each question are suggestions as to the method to be used in answering it. Fifty-eight experiments for the solution of some of the questions are described, often with the aid of good figures. The numerous references to important literature affecting the subject will be of great value

to those who have access to a good botanical library. The favoured students who have ample time and the use of the rather costly equipment to undertake such a course in practical plant physiology will, we have no hesitation in saying, find Prof. Ganong's little book a competent and trustworthy guide.

"THE SCIENCE OF MECHANICS." By Dr. Ernest Mach. Translated from the German by T. G. McCormack. Second English edition. Pp. xix. and 605. (Kegan Paul.) 9s. 6d. net. Illustrated.—No work in existence contains such a philosophical and inspiring account of the principles of mechanics in relation to their development as Prof. Mach's, rendered into fluent English by Mr. T. G. McCormack. The student of physical science who obtains from this book his concepts concerning the motions and equilibrium of masses is to be congratulated. Mechanics is not treated as a collection of problems having no connection with one another or with anything real in nature, but as one of the physical sciences. To the student familiar with the arid specifications of the principles of statics as expressed and illustrated in text-books in general, the treatment of the same subject by Prof. Mach comes as a revelation. The long chapter on dynamics is of especial interest to students of astronomy; the remaining chapters deal with the application of the principles of mechanics and the deductive development of the science, the formal development of mechanics, and the relations of mechanics to physics and physiology. To this new edition of what is everywhere regarded as a scientific classic, an appendix of eighty pages has been added, containing Prof. Mach's supplementary remarks upon various parts of the text. For its logic, history, and scientific scope, we commend the book most heartily to all serious students of matter and motion.

"DYNAMIC ASPECTS OF NUTRITION AND HEREDITY." By Frank Horridge. Pp. xiv., 175. (Baillière, Tindall & Cox.) 5s. net.—The titles of the three chapters of this book are "The Active Forces of Living Organisms," "The Spinal Cord and the Functions of the Cerebellum," and "Heredity." No useful purpose would be served by either describing or criticising the author's material or conclusions. Suffice it to say that an endeavour is made to connect physical and nervous effects and phenomena. Preventive and curative medicine are shown to depend for their results upon movements in the ether, and the cerebellum is regarded as a reinforcing organ to the nervous system. Lovers of speculative science may discover some ideas to interest them, but critical students will find the book a weariness of the flesh.

BOOKS RECEIVED.

The Relation of Science to Art. By Sir Samuel Wilks, Bart., M.D., LL.D., F.R.S. (Hampstead: Sydney C. Mayle.) 6d.

Manual of Astronomy. By Charles A. Young, PH.D., LL.D. (Ginn & Co.) Illustrated. 10s. 6d.

Animal Forms. By David S. Jordan, M.S., M.D., PH.D., LL.D., and Harold Heath, PH.D. (Hirschfeld.) Illustrated. 6s. net.

Elementary Principles of Chemistry. By A. V. E. Young. (Hirschfeld.) Illustrated. 5s. net.

Elements of Physics. By C. Hanford Henderson, PH.D., and John F. Woodhull, PH.D. (Hirschfeld.) Illustrated. 5s. net.

Early Life of the Young Cuckoo. By W. Percival Westell, M.B.O.U. (Thomas Burleigh.) Illustrated. 1s. net.

European Fungus Flora Agaricaceæ. By George Massee, F.L.S. (Duckworth & Co.) 6s. net.

Analysis of English History. By W. C. Pearce and Dr. S. Hague, LL.B. Revised by W. F. Baugust. (Murby.) 1s.

Principles of Simple Photography. By Fred. W. Sparrow, R.N. (Hazell, Watson & Viney.) Illustrated. 1s. net.

Preparatory Lessons in Chemistry. By Henry W. Hill. (Allman & Son.) Illustrated. 1s.

Macaulay's Lays—Horatius, Lake Regillus, Armada and Ivry. Edited by W. J. Addis, B.A. (Allman & Son.) 1s.

Aërial Navigation. By Frederick Walker, C.E. (Crosby Lockwood.) Illustrated. 7s. 6d. net.

The Mill on the Floss. By George Eliot. (Ward, Lock.) 1s. 6d.

Electric Wiring. By W. C. Clinton, B.SC. (Murray.) Illustrated. 1s. 6d.

Report of the Yellow Fever Expedition to Parà (Liverpool School of Tropical Medicine—Memoir VII.). By H. E. Durham. (Longmans.) 7s. 6d.

Experiments in Aerodynamics. By S. P. Langley. (Washington: Smithsonian Institution.)

Memorias y Revista de la Sociedad Científica "Antonio Alzate." Nos. 4 and 5 and 6. (Mexico: Imprenta del Gobierno en el ex-Arzobispado.)

New Phytologist. Vol. I., No. 7. Monthly. 1s. 6d.

Board of Education—Supplementary Regulations for Secondary Day Schools and for Evening Schools (From 1st August, 1902, to 31st July, 1903). (Eyre & Spottiswoode.) 4d.

Eastern Uganda—an Ethnological Survey. By C. W. Hobley, ASSOC.M.INST.C.E. (Anthropological Institute.)

Ross Bird-Stalker. By Charles Dixon. (Ross Ld.) Illustrated. 6d.

Orchard and Bush-Fruit Pests and How to Combat Them. By Cecil Warburton, M.A., F.E.S. (Murray.) Illustrated. 6d.

Bi-literal Cypher of Francis Bacon. Replies to Criticisms. By Elizabeth Wells Gallup. (Gay & Bird.)

ARCTIC OCEANOGRAPHY.*

THE truth of the old proverb, "It is the unexpected that happens," is seldom more forcibly illustrated than by this volume. When Dr. Nansen prepared for his adventurous voyage, against the advice of all whose experience of arctic expeditions entitled them to form an opinion, he expected to be carried in the drifting ice across a comparatively shallow sea, and the provision of oceanographical instruments and gear was made in this belief. He carried out his programme to the letter as far as the surface drift was concerned, but he discovered too late that the Polar Sea was one of the deepest instead of one of the shallowest of the oceanic areas, and research in its depths was only possible by means of gear made or adapted on board. It was naturally a great disappointment to Dr. Nansen to find that his most valuable results were shorn of their completeness by the want of a few thousand fathoms of wire. He realised, too, that when working in the deep sea from the solid surface of the ice a far higher degree of accuracy was possible in oceanographical observations than the vicissitudes of a tossing ship, often under the command of an impatient officer, had allowed his predecessors to dream of. On his return he proceeded to devise and test instruments of high precision, and the result has been to turn Dr. Nansen from a biologist into a physical oceanographer. We may consequently expect developments of a very interesting kind from the Laboratory of the International Council for the Study of the Sea, which is shortly to be opened at Christiana under his direction.

After a full confession of the incompleteness of the "Fram's" oceanographical work in the preface to the first memoir, "On the Oceanography of the North Polar Basin," Dr. Nansen goes on to describe and criticise his instruments, "nothing extenuating" as to their defects, to tabulate his observations with a running commentary as to their probable errors, and finally to deduce his conclusions with a caution, and at the same time an independence and originality which inspire confidence and respect. There is a good deal in this great volume to nourish discussion, and it might not be difficult to combat some of the more theoretical conclusions, but in a short account of such a harvest from a field hitherto untrodden and untouched it is better to pay attention only to the heap of beaten-out grain.

It is hardly necessary to recapitulate the route of the "Fram," but nevertheless there may be some readers who will not resent a few lines of orientation. The ship left Vardö on July 21st, 1893, passed through the Yugor Strait early in August, coasted the Yalmal peninsula, rounded

* "The Norwegian North Polar Expedition, 1893-1896. Scientific Results." Edited by Fridtjof Nansen. Vol. III. Published by the Fridtjof Nansen Fund for the Advancement of Science. (London: Longmans, Green & Co.) 1902.

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Cape Chelyuskin, the most northerly point of Asia, on September 11th, and entered the ice north of the New Siberian Islands on September 22nd, in 78° 50′ N. From this time she drifted with the ice, being about 79° N., 138° E. on 1st January, 1894, in 83½° N., 102° E. on 1st January, 1895, in almost 86° N., 67° E. (her farthest north) on 15th November, in 85½° N., 47° E. on 1st January, 1896, and in the middle of July she broke out of the ice in 84° N., 15° E., to the north of Spitsbergen. Along the whole of this extensive route, which was traversed by the "Fram" in many devious loops, observations were made at frequent intervals by lowering thermometers and water-bottles through openings broken in the ice. At least nine observations were made at depths of 1000 fathoms or more, and were it not for the risk of breaking the only available sounding-line, which was wearing thin with use, many others would have been obtained.

In discussing the instruments and observations, Dr. Nansen has much to say as to their corrections and the probable errors of observation, and if he errs in this matter it is by the perhaps unnecessary refinement of some corrections. These corrections also were in many cases suggested by laboratory work subsequent to the return of the expedition, and if they had been thought of when the observations were made, some little advantage might have resulted. They will, however, bear good fruit in subsequent expeditions. As they stand, Dr. Nansen's observations are at least as accurate and trustworthy as the best work of his predecessors; but there is no doubt that in the conditions of the polar seas, with a very small range of temperature, and with solid ice to work from, far greater refinements in observational methods are possible than in the open ocean.

The primary object of investigating the temperature and salinity of the water was to throw light on the circulation of that part of the ocean. The observed facts were that a layer of cold and comparatively fresh water, probably due to the great rivers of Northern Asia, covered the surface of the Polar Basin to a depth of about 100 fathoms. Beneath this a distinctly warmer and much salter body of water was found, its high salinity being maintained to the bottom, while its temperature came to a maximum at a depth of about 200 fathoms, from which plane it falls gradually to a minimum near the bottom, but never becomes so cold as the surface layer. This appears to be Atlantic water in course of cooling down, and the very slight rise of temperature observed in it at the bottom is attributed to the influence of the internal heat of the earth.

The curves of temperature, salinity, density *in situ*, and the isosteres, or lines of specific volume calculated according to Bjerknes' method, afford a basis for estimating the forces tending to produce circulation in the water, and taking all these into account Dr. Nansen comes to the following conclusion.

There are at least four systems of currents in a vertical section along the route of the "Fram." (1) A surface current of low salinity (29 to 32 per mille) about 20 metres deep running towards the north-west and west. (2) An underlying slow current of high salinity and very low temperature running in a different direction and consisting of surface water from other parts of the Arctic Sea. (3) A current of relatively warm water of high salinity (35·1 to 35·3 per mille) coming from the Gulf Stream, west of Spitsbergen, and running towards the east at depths below 250 metres. (4) An extremely slow current of colder water filling the deepest part of the basin (below 1000 metres), forming the densest part of the preceding current which has been cooled down and sunk. In the mass of this very slow-moving current which may not renew the water in the Polar Basin once in several centuries, Dr. Nansen believes that the internal heat of the earth may give rise to a system of vertical circulation.

The whole of this difficult subject is discussed at great length, but we cannot say that the difficulties which present themselves to our mind are removed. Of these the chief is why warm Atlantic water penetrating the Polar Basin beneath a sheet of very cold water of low salinity should cool more rapidly downward than upward. There must, we should think, be a system of oblique circulation to produce this effect, such as might be produced by the wind.

In dealing with the surface current, the demonstration of the existence of which gave Dr. Nansen confidence in his plan of a drift-voyage, we are on surer ground. The fact that the "Fram" followed the route which she was expected to traverse of course proved the main fact that there was a drift of ice from the Siberian towards the Greenland side of the basin. It did not, however, prove whether the ice was simply drifted over by the wind, or carried along by a definite ocean current irrespective of the wind. Wind-drift was, of course, a very powerful factor, as the curious tangled track of the "Fram" clearly proves, but when the influence of the wind was eliminated by considerable periods during which the wind resultant was zero, a residual drift due to a permanent current was plainly visible. This permanent current had an average velocity of 0·73 nautical mile in 24 hours. That the permanent current was in the main independent of wind-drift appears from the fact that the mean rate of the wind-drift was only 0·52 nautical mile in 24 hours, and its direction was substantially different. The primary cause of the permanent surface current is considered to be the volume of fresh water poured in by the Siberian rivers.

In his discussion of the circulation of water in the Polar Basin, Dr. Nansen makes very large use of the deviation due to the rotation of the earth, as it affects vertical as well as horizontal movements. He employs this hypothesis in constructing a scheme of the probable circulation of the unknown parts of the North Polar area, but points out the uncertainty arising from our ignorance of the configuration of the American margin of the basin, which must have a great influence on the movement of the waters.

Some remarkable relationships are brought out by a comparison of the oceanographical conditions of the North Polar Basin and of the Norwegian Sea. Contradictory as it may appear to our natural opinion, the bottom water in the North Polar Basin is warmer and salter than that in the Norwegian Sea at the same depth. Thus, between Norway and Iceland, bottom temperatures of — 1°·1 C. or lower are obtained, while the coldest bottom water met with by the "Fram" was only — 0°·87 C. Hence it is necessary to assume that the basins of the two seas are separated by a sub-oceanic ridge extending from Spitsbergen to Greenland. The cold and comparatively fresh East Greenland and East Iceland polar currents are, in Dr. Nansen's opinion, simply the outflow of the surface water of the Arctic Sea, consisting of Atlantic water freshened by the Siberian rivers, and containing a quite insignificant proportion of fresh water due to melting ice.

Much work must still be done in the northern seas before all the problems are satisfactorily solved, but the outcome of the "Fram's" researches is to give a certain basis of fact from which a multitude of fresh ideas will spring, each demanding new and exact observations before it can be settled. We would much like to see the drift of the "Fram" repeated, say from Bering Strait, in a vessel fully equipped for oceanographical work, and we would venture to urge

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that this should be undertaken even in face of the incomprehensible fate which has hitherto decreed that the first attempt at a new route or method of exploration in the Arctic regions is always more successful than any subsequent endeavour on the same lines.

Dr. Nansen has something to say with regard to the interesting question of the climate of the Arctic regions in past geological periods. He points out that the superficial layer of light cold water exercises a cooling influence on the atmosphere in several ways. If any change had occurred in the courses of the great Siberian and American rivers, diverting their water from the Polar Basin, or any change in the configuration or depth of the basin itself, the cold surface layer might also have disappeared. A raising of the sea-level by 1000 metres would admit a far greater volume of warm Atlantic water and mitigate the climate to a very marked degree, a fall of the sea-level by even 500 metres would produce a still more pronounced effect in the opposite direction, and there is evidence that such changes have occurred in the past Thus Dr. Nansen's results afford fresh data for attacking the semi-fossil problem of the cause of glacial periods.

After the perusal of a memoir so full of new facts and far-reaching suggestions, we come as a sort of anti-climax to a paper on "Hydrometers and the Surface Tension of Liquids," which is included in the volume. The subject is of importance, because hydrometers have had much to do with ascertaining the facts as to the salinity, not of the North Polar Basin alone, but of all parts of the ocean. It is a question full of difficulty, on which there exists a considerable literature, and about which controversies of some intensity have arisen. Dr. Nansen traces the bad reputation of the ordinary hydrometer to the capricious variations of surface tension in liquids which have been contaminated by any greasy substance, and he describes a series of experiments resulting in a method of skimming and cleansing the surface, which enables a hydrometer to be used with more certainty of a good result than was before considered possible. We believe that with care in the use of ungreased water-bottles, clean utensils, and frequently-washed hands, surface tension may not prove so formidable a variable as Dr. Nansen's experiments seem to suggest. However, there is no doubt that the use of the stemless or total immersion hydrometer recommended by Dr Nansen promises to simplify the labour, and to improve the accuracy of density determinations at sea. He proposes to employ a set of cylindrical hydrometers without stems, one of which, having a specific gravity very near that of the sample of water to be tested, is immersed in it, the containing jar being constructed with a vacuum jacket on Professor Dewar's principle. A delicate thermometer is also immersed in the water, and the temperature is raised or lowered by stirring with a closed glass tube containing ice, or a similar tube containing warm water, until the float is in exact equilibrium with the water. The only reading required is that of the temperature, as the weight, volume, and expansibility of the hydrometer have been previously ascertained.

There is still a great future before oceanography. Every year demonstrates more clearly the intimate relation between the temperature of the sea surface and climate, and such works as this prove that the temperature of the sea surface can only be understood by the investigation of the conditions of the mass of the water at all depths. In some parts of his investigations Dr. Nansen introduces mathematical treatment, which is now fairly justified by the improved data available for discussion, and we would commend some of the problems touched upon to the tutors of Cambridge as not unworthy of their attention.

STUDIES IN THE BRITISH FLORA.

By R. LLOYD PRAEGER, B.A.

V.—ON AN IRISH BOG.

LEAVING the county road, we strike down a bohereen—a "roadling," to use the English equivalent—towards where the brown edge of the peat bog rises a couple of fields away. On one side of the lane is a broad ditch of still brown peat water, which the sloping sunlight brightens to a rich amber. The patches of brown-leaved *Potamogeton coloratus* which grow below the surface harmonize well with the dominating tint of water and soil; and in startling contrast to these the light strikes on cloud-like masses of *Chara fragilis*, here quite free from limy incrustation, and vivid in their greenness. On the other hand, flat peaty meadows extend, full of Yellow-Rattle and *Agrostis vulgaris*. The Orchids like this ground, and amid the pink and red spikes of *O. maculata* and *incarnata*, we see the greeny white of *Habenaria chloroleuca* and *H. bifolia*, and the fragrant purple pyramids of *H. conopsea*. More sparingly, in a drier spot, is a colony of the beautiful Bee Orchis (*Ophrys apifera*), and the little Frog Orchis (*H. viridis*). We pass to a flat expanse of almost bare peat, where *Agrostis vulgaris* and *Rumex Acetosella* are only just obtaining a hold, and *Senecio sylvaticus* shifts about season by season. This ground is used for drying and stacking the peat after it has been cut from the neighbouring bank. The cutting is done somewhat irregularly, and we surmount several successive steps, and rising some fifteen feet, find ourselves on the heathy surface of the bog. This portion has slipped and shrunk owing to the drainage induced by the turf-cutting; and while the Ling appears benefited by the change, most of the plants look starved, and the little pools are all dry. So we push upward and onward through the heath. Soon brilliant patches of Bog-moss, or *Sphagnum*—green, yellow and crimson—make their appearance, the surface pools are filled with water and fringed with Sundews, the cultivated land is lost to sight behind us. A couple of stunted Birches, the only break in the sky-line in front of us, give something to steer for. A Curlew rises with a loud whistle. We pause, as the bubbling water reminds us at every step that we are now beyond the influence of turf-cutting and drainage, to examine the flora at leisure.

The plants which form the vegetation here constitute a very distinct association; very homogeneous, too, though limited in variety. Wander as we will, we scarcely enlarge the plant-list formed in our minds by our first scrutinising glance. The dominating species, and the one which gives the general surface its appearance and colour, is the Ling, *Calluna Erica*. With it, in smaller quantity, is the Bell-heather, *Erica Tetralix*. The great green and red cushions of *Sphagnum* form a conspicuous feature. Two other ericaceous plants, *Andromeda Polifolia* and the Cranberry, *Vaccinium Oxycoccus*, appear to like the shelter and cool dampness which these mosses afford; their struggling stems wind far into the depths of the *Sphagnum*, while their leaves and flowers brighten its surface. Great grey cushions of a drier nature are formed here and there by another moss, *Rhacomitrium lanuginosum*; some of these rise three feet above the general surface of the bog. Almost as abundant as the Ling are two other plants, the beautiful little Bog Asphodel, *Narthecium ossifragum*, with its golden stars of blossom and Iris-like leaves, and the Club-rush *Scirpus cæspitosus*, growing in tufts with stiff radiating stems, like glorified pin-cushions. Both the Cotton-grasses, *Eriophorum angustifolium* and *E. vaginatum*, are here, though sparingly, and that quaint erect little plant, looking strangely out of place, is the Fir Club-moss, *Lycopodium Selago*. The oozy sinuous

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pools are filled with *Sphagnum*, and here and there with the Bog-bean, *Menyanthes trifoliata*; the edges of the pools are luxuriously cushioned with a variegated growth of *Sphagnum*, and these edges are the favourite haunt of two of those wonderful fly-devouring Sundews, *Drosera rotundifolia* and *D. anglica*. In the shallower pools, or on bare mud, the White Beak-rush, *Rhynchospora alba*, grows in tufts, and its farther-creeping relative, *R. fusca*, fills portions of the pools with an erect growth of bright green stems and brown inflorescence. These, with some subsidiary mosses and lichens, complete the flora of our bog.

The conditions under which this plant-group lives are remarkable. The spongy crust is perennially saturated with water, which circulates very slowly. In consequence the soil is badly aerated, and the plant-remains which form the crust do not become thoroughly oxidized, and soluble humus compounds remain in solution in the water. The plants can with difficulty absorb by their roots water charged with these substances, and thus it comes to pass that while the bog is physically very wet, physiologically it is very dry. In the midst of plenty the plants are actually starving. It is, indeed, a true case of

"Water, water everywhere,
Nor any drop to drink."

Exactly the same difficulty, it may be remarked, occurs in salt marshes, where the water is charged with sodium chloride. In both cases the plants meet it in the same way, by checking transpiration, and thus saving up the water which they absorb. Thus they assume characters similar to those displayed by plants of deserts and dry places—xerophytic characters, to return to a term which we have had occasion to use before. These are seen in the smallness of the leaves of the Heaths, for example, as well as in the curious backward-rolled character of their leaves, as well as of those of the Cranberry, Crowberry, etc. In other cases the leaves are protected by a thick impervious cuticle or skin, or by a close growth of hairs. Another peculiarity in the conditions under which the bog flora grows is that in the water-logged soil there are no bacteria present, which are so useful in breaking up the complicated nitrogenous compounds contained in the dead plant matter; hence nitrogen as a plant food is scarce. This may help to explain why the Sundews, which are essentially bog-plants, have hit upon the extraordinary manner of obtaining nitrogenous food for which they are famous—the capturing, killing and digesting of small animals.

The flora of our bog has one peculiar point of interest—it is one of the few plant-associations now to be found which is absolutely uninfluenced by ubiquitous man and his works. Over almost the whole of our islands the surface is under his control; even on the mountain-tops his sheep nibble the herbage and influence the flora, but here not even the sheep venture; the flora, the relative abundance of its constituent species, their dimensions and form, are purely natural. The fauna is natural likewise. A few Hares here find a secure retreat. The lonely Curlew makes its nest among the Ling, and the alert little Merlin selects for its breeding-haunt some spot where a mound or high tuft of moss furnishes it with a look-out tower. But the leading inhabitant of the great bogs, and the only one which conspicuously affects its flora, is the Black-headed Gull. This bird, selecting a remote piece of bog with numerous pools, forms breeding colonies containing sometimes thousands of nests. The effect on the bog flora is disastrous. Owing partly to the tramping, and probably more to the guano, plant after plant succumbs, until from the most thickly populated spots all are gone. In their place there springs up a vegetation less exclusive in its tastes and more tolerant of disturbance and of manuring. The seeds of these plants presumably come mostly adhering to the birds' feet, from the pastures and cultivated land where the Black-headed Gull mainly forages. Tall clumps of rushes spring up and grasses of several kinds, and with them Buttercups and Daisies, Chickweed and Groundsel, and many other weeds—a complete change of flora such as we seldom find except in connection with that arch-meddler, man.

We wander back to the edge of the bog, where the turf-cutters have, in the course of half a century, effected quite an appreciable nibbling into the vast brown vegetable mass. The section exposed by their operations is interesting. For a few feet from the surface the peat is loose and spongy and dries to a yellow colour, and in it we can detect plentiful remains of the plants which still flourish on its surface—stems of Heather, the far-creeping rhizomes of the Cotton-grass, and much *Sphagnum*. Below that the peat becomes more decayed, darker in colour and denser in texture, till at length it is a compact brown vegetable mud. In these lower layers are numerous great stumps of trees—Fir and Oak—with far-spreading roots. The lowest layer of black peat rests with startling contrast on a band of pure white marl, which in its turn is succeeded by a tough grey stony clay, which we recognise as the weathered surface-layer of the limestone drift, or Boulder clay, that is so thickly spread over the Central Plain of Ireland. Here, then, is a series of deposits which bridge over the great gap of time between the Ice Age and the present day—perhaps thirty thousand, perhaps sixty thousand years. Let us see what light the plant-remains which may be found in these deposits can throw on the successive floras that have occupied the surface during this vast period; thus we may link the present with the past, and learn something of the history of our existing vegetation, and of its ancestry.

During the Glacial period, ice covered a great portion of our country. The clays and gravels, full of ice-scratched blocks, often yield also marine shells, and these are largely of northern and arctic type, betokening very cold seas. Have any plants of this rigorous period survived, and what do they tell us? We may take in answer one of the interesting series of deposits discovered by the late Mr. Bennie, in the neighbourhood of Edinburgh. In a cutting at Corstorphine, lying on Boulder clay, the following beds occurred in ascending order*:—

1. Coarse grey sand, with stones. } The residue of the
2. Fine laminated clay. } Boulder clay.
3. Layers of fine clay, mud, or silt, with leaves and seeds in thin layers, or scattered.
4. Lake marl—a calcareous mud, crowded with the ordinary lake shells, and felted with stems of water plants.
5. Ochrey sand and gravel, six to seven feet thick, with little or nothing organic.

It is this bed 3 to which our attention must especially be directed. The plant-remains, worked out by Mr. Clement Reid, make the old flora which clothed Corstorphine Hill spread itself again before us. We see low Willows and Birches and Brambles clustering here and there, and while some of these still flourish in the district, others are now restricted to the mountain-tops, and others again have retreated to within the Arctic Circle. The Mountain Sorrel and Mountain Dryas, now alpine in their distribution, are here too, and many plants of moors and bogs, such as Sedges, Club-rushes, Bog-bean, Marsh Andromeda, and Crowberry. These no doubt grew around the marshy edges of the shallow pools, in which the plant-

* Bennie: "Arctic Plants of the Old Lake Deposits of Scotland." *Ann. Scott. Nat. Hist.*, January, 1894.

remains collected. But drier ground was near at hand, for with these, seeds of some of our most familiar wayside plants occur—the ubiquitous Chickweed, Buttercups and Violets, and that

> "Dear common flower, that grow'st beside the way,
> Fringing the dusty road with harmless gold,
> First pledge of blithesome May."

—the Dandelion. But the flora is distinctly northern, and the Arctic plants are indicative, says Mr. Bennie, of a climate 20° Fahrenheit colder than at present—a climate that would allow the Glacial Period to reign supreme.

At Hailes, not far away, two plant-beds were found.* The lower, resting directly on the Boulder clay, yielded a flora with arctic Willows, resembling that just described. Above this lay silts which yielded quite an extensive flora no longer arctic and stunted, but consisting of temperate plants, such as now occupy the country—Oak, Fir, Hazel, Birch, Alder, Black-thorn, and Bird-cherry; King-cups and Catchflies, Wood-sorrel, Meadow-sweet, Valerian, Red-rattle, Gipsywort, Bugle, Mercury, and Dock.

The white lake-marl, which underlies our bog, and which we have seen to overlie the glacial plant-bed at Corstorphine, is a deposit widely spread in our islands, and frequently met with. The passing away of the ice left the country strewn with ridges and mounds of clay and gravel, which, interfering with the old drainage, conduced to form numerous lakes and pools. And as the country became again clothed with trees and herbaceous vegetation, the waters also were colonized by an abundant flora, which advanced from the south as the ice retreated further and further northward. Among the plants which flourished were quantities of *Characeæ* or Stoneworts, many of which have their stems habitually encrusted with lime, whenever a sufficiency of lime is dissolved in the water. Various plant-eating water-snails swarmed in these pools, and also water-fleas or *Entomostraca*, which have calcareous tests. As generation after generation of these plants and animals came and went, their limy crusts or shells fell to the bottom of the pools, and by degrees formed these white beds of marl. The process may still be seen in actual operation. Mr. Skertchly found† that the evaporation of the water in the ditches of Burwell Fen during the exceptional drought of 1874 left a white deposit of *Chara* remains from two to four inches in thickness. If a sample of this white marl be examined carefully, the roots and seeds of *Chara* may almost always be found, and there can be little doubt that plants of this genus largely contributed to its formation. The conditions under which a deposit of the kind would form are such as still obtain around our bog. First, the water must be charged with carbonate of lime—in the great limestone plain of Ireland it is difficult to find water that is not! The water must be clear, for Charas do not favour muddy pools; and the pools must be of moderate depth. To judge from the wide range of these marls, such conditions must have been frequently fulfilled in the post-Glacial lakes. The marls are poor in plant-remains in general. The still clear waters in which they were formed would not receive seeds and fragments of the shore vegetation in the ordinary course, as would a turbid pool through which a stream ran; and the material itself is far less fitted to preserve plant-remains than beds of fine silt. Nevertheless, in a sample of the marl taken not very far from the spot where we now in fancy stand, Mr. Clement Reid found‡ seeds of Water-buttercup, Milfoil, Shore-weed, Club-rushes, Sedges, and two Pondweeds, all being plants, it will be noticed, that would grow in the pool or on its edges. Water-snails, which delight in clear limy waters, were abundant in these old lakes, and their shells sometimes form a considerable portion of the deposits. Several species of *Limnæa*, *Succinea*, and *Valvata* are often present in numbers, and also representatives of the genera *Sphærium*, *Planorbis*, *Physa*, *Bythinia*, *Pisidium*, &c., all being species which are still abundant in our ponds; so that the fossils, both vegetable and animal, point to a climate hardly distinguishable from that which now obtains, and to a flora and fauna closely resembling the present. One characteristic fossil of these Irish marls has, however, yet to be mentioned. It is in these deposits rather than in the peat which overlies them that the remains of the Great Irish Deer, *Cervus giganteus*, commonly known as the Irish Elk, occur, often in surprising quantity. This splendid animal stood as much as 21 hands, or 7 feet high, and its antlers measured 10 feet or more across; it attained an abundance in Ireland unequalled elsewhere in its range, which stretches chiefly over northern Europe (though reaching as far south as Italy) into Siberia. In the old bed of one small lake among the hills of County Dublin, over one hundred heads have been obtained. Appearing in these countries after the Great Ice Age, this noble animal must have been roaming the plains in thousands at the time when the slow accumulation of limy sediment was forming these white marls; ere the forest period which succeeded had arrived, the Great Deer had vanished from the face of our planet.

Thus have we briefly sketched, by means of the plant-remains embedded in contemporary deposits, the history of the flora of our country, from the repeopling of the land on the departure of the ice to the time when many of the lakes which formed on the surface of the Boulder clay had silted up. Immediately overlying the white marl in the turf cuttings of our bog are the lowest layers of the peat which rises full thirty feet in thickness. The history of the bogs—their birth, life, and death—must form the theme of a subsequent chapter.

* Clement Reid: "Origin of the British Flora," p. 72-74. 1899.

† *Mem. Geol. Survey England and Wales: Geology of parts of Cambridgeshire and of Suffolk*, pp. 98, 99. 1891.

‡ "On the Origin of Migaceros-marl." *Irish Naturalist*, IV., pp. 131, 132. 1895.

COLLECTING, PRESERVING, AND MOUNTING ALGÆ.

By HENRY J. FOSTER.

MANY microscopists would be glad to be acquainted with the best methods for collecting, preserving, and mounting as microscopical specimens, the beautiful varieties of marine and fresh-water Algæ, and the information that it is here proposed to give will, it is hoped, enable this to be done.

It will be found desirable to combine both the marine and fresh-water varieties in collections, for in their botanical arrangement according to structure and modes of growth, the steps in the scale of nature towards higher forms are independent of the accident of habitat. The exquisite structure, differing in every species, causes these subjects to be of especial interest to the microscopist, and that interest is immensely increased when he has collected, prepared, and mounted the specimens for himself. Although it is eminently desirable that classification and nomenclature should be attempted, it is of course not an essential; but there is little doubt that preliminary observation will ultimately lead to fuller investigation, and perhaps to real study.

MARINE ALGÆ.—If the collection of these specimens is to be an object in a visit to the seaside, it will be well to choose for preference a rocky and perhaps somewhat bleak coast, where there is an abundance of rock pools.

The low sandy shore or flat muddy estuary, though yielding their peculiar species, are not by comparison to be considered.

Mr. George Murray in his introduction to the Study of Seaweeds gives the following information regarding the three colours of seaweeds:—"As a general rule the inshore seaweeds near high-water mark are green in colour like land vegetation, and lower down between tide-marks there is a belt of olive forms sheltering red plants beneath them. Where rocks overhang the bottom and in small pools these red forms also occur at this level. At extreme low-water mark and beyond it are found the brown tangles sheltering red forms again, while at the lowest depths of plant life in the sea the red forms occur without shelter."

The collector should provide himself with some small tin boxes, such as are used by botanists, and these should contain little oiled silk bags in which to place the specimens; or an ordinary water-proof sponge bag hung on the arm is a good receptacle. A strong short chisel, firmly fixed at the end of a stout stick of alpenstock pattern, and having at the other end a small net, is also necessary, the former to dislodge pieces of weed from shells or rocks otherwise beyond reach, the latter to catch floating specimens. The stick will also be found useful as a support when on the rocks, for it is here when the tide is at its farthest that he will have to search for his treasures.

They will be found in the little pools about the rocks, some growing on pebbles, others on shells, while some will spring from the rock itself. After a storm is a particularly propitious time for search to be made along the shore, for tufts will frequently be torn from inaccessible regions, while at other times a variety of specimens will be found thrown up by the waves and stranded on the beach. The waste of a fisherman's haul should also be examined.

Specimens thus secured may be preserved in sea water without deterioration, and in particular Delesseria alata, Polysiphonia, Callithamnion, and Bryopsis ulva thrive well in aquaria. The collected material should be placed in transparent receptacles, such as glass jars, so that they may be readily examined.

Marine Algæ make particularly good dried specimens, and the method to be adopted for preserving them in this manner is as follows:—They should be thoroughly washed, first in salt water and finally in fresh water. The specimen should then be placed in a shallow dish, and a sheet of drawing paper gently placed beneath it as it floats in the water; the paper may then be gradually drawn up and the specimen thus lifted in its spread out condition. The specimens so arranged should then be carefully covered with drying paper, and botanical pressure boards or a board with a considerable weight upon it should be used, the papers being changed frequently until the specimens are quite dry.

It has to be remembered that the dried specimens rarely retain the beautiful colours of the living plant. In many cases the chlorophyll granules are embedded in the pigments of various colours, and are sometimes almost indiscernible.

On the death of the plant these colouring matters frequently undergo a change, and much of the beauty of the specimen is thereby lost.

The process of mounting marine Algæ for the microscope is quite simple, and with care and practice the work can be done with great facility. The *modus operandi* is as follows:—The weed should be well washed in the same manner as for dry mounting, and the portion which shows the most interesting structure—fructification, etc., if possible— should then be removed with a sharp pair of scissors and transferred with the forceps to a 3 by 1″ slip. It is then carefully drained of superfluous water by a cloth placed close to it to absorb the moisture. It must not, however, be allowed to get perfectly dry.

The best medium for mounting is Deane's gelatine, which is reduced to a fluid condition by placing the bottle containing it in a bath of hot water. The slips should now be very gently warmed, and a small quantity of the medium transferred, by means of a warm glass rod, from the bottle to the slip. The amount of medium should be just sufficient in quantity for a $\frac{3}{4}$″ circle to cover comfortably.

The cover-glass having been warmed in a spirit lamp flame on the side which is to be away from the specimen, is gradually tilted down on the specimen and the slide set aside to cool, the exuded gelatine being removed when hard by means of a knife and a piece of soft sponge dipped in warm water, and used as rapidly as possible. It may subsequently be finished with any of the varnish cements.

For travelling purposes the majority of the specimens may be safely carried in wide-mouthed bottles with well-fitting corks, and many species will keep thus for months or even years, but some delicate specimens, such as Callithamnion corymbosum, Sphondylothamnion multifidium, and Mesogloea, are best kept in glycerine until required for mounting, the glycerine being washed off beforehand.

The corallines are red sea-weeds whose tissues are hardened by chloride of lime. Before mounting they must be cleared by washing in a weak solution of hydrochloric acid, or, better still, by using Perenyi's decalcifying fluid.

FRESH-WATER ALGÆ. — The majority of specimens when collected require to be placed and carried in water, necessitating that the collector shall take with him some well-corked wide-mouthed bottles.

One of the most generally useful arrangements for gathering specimens is one of the collecting sticks sold by opticians, which is provided with net, bottle, cutting hook, drags, etc. These various fittings enable all kinds to be taken—the free-swimming Volvox, the floating Spirogyra, and the Desmids and Diatoms, which may be found in the mud at the bottom.

It will often be found convenient to concentrate gatherings, which may be done by stretching a piece of fine muslin across a bottle, superfluous water being drained away and the specimens retained, and all placed in one instead of several bottles.

To preserve fresh-water Algæ, it will be found advantageous to shield them from direct light by tying a stiff piece of green paper round the vessel in which they are contained.

In mounting these specimens for microscopical examination, the same processes may generally be adopted as for marine Algæ, excepting that of course the salt-water washing is omitted, but the delicate structure of many of the species necessitates their being mounted in a cell. The medium that has proved most generally satisfactory is Deane's gelatine, thinned with camphor water, or with distilled water containing a trace of pure carbolic acid. The gelatine keeps the medium from evaporation, and is easier to use than an ordinary fluid. Some species, such as Enteromorpha, may be mounted in the Deane's medium without dilution. Spirogyra and Volvox are better mounted with Deane's gelatine 50 per cent., and thinning material for the other half. Spirogyra may also be mounted in dilute alcohol, and this shows up the nucleus, although the colour suffers.

Specimens mounted in fluid or semi-fluid media should be sealed up immediately in order to prevent evaporation. This is best done with a ring of Hollis's glue, and care should be taken to finish with a sufficiency of varnish to prevent all chance of evaporation at later periods.

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Conducted by M. I. CROSS.

POND-LIFE COLLECTING IN SEPTEMBER.—In normal years many of the dried-up ponds begin to fill up again in September, and become then most prolific in Infusorian and Rotiferous life, because the disturbing Crustaceans, Cyclops and Cladocera, have been to a large extent eliminated. But also in larger ponds and lakes, which do not dry up, the Crustaceans decrease in numbers and give the Rotifera and Infusoria a fresh chance of increase. The following free-swimming forms may often be collected in immense numbers by means of the Queketter's collecting net and bottle: *Asplanchna priodonta, intermedia* and *brightwelli*; *Triarthra longiseta*; *Polyarthra platyptera*; *Synchaeta pectinata, tremula* and *oblonga*; *Anurœa aculeata* and *cochlearis*; *Brachionus angularis*; *Pedalion mirum*; *Conochilus unicornis*; and the much rarer *Floscularia pelagica*. Of the fixed forms *Limnias ceratophylli* and *annulatus, Cephalosiphon limnias, Lacinularia socialis, Melicerta ringens* and *conifera* should be looked for on submerged water plants, such as Anacharis, Ceratophyllum, Nitella, and on the rootlets of Duckweed. Polyzoa such as Plumatella, Lophopus, Cristatella, should be found in abundance in disused canals and backwaters of rivers and the larger lakes, from which they should be dredged with a loaded hook and line.

It may be taken as a general rule that all the more interesting forms of Pond-life become more abundant in September, provided only the weather is not too hot, but tempered by repeated showers to fill the dried-up ponds with a fresh supply of rain water.

MICROTOMES.—The selection of a microtome is largely dependent on the description and quality of the work that it is proposed to do. The majority of amateurs find their aims satisfied with the ordinary well microtomes which are made in numerous forms; and for those who do occasional work, and that not of the finest kind, in which sections of extreme tenuity would be essential, these are undoubtedly good and satisfactory.

Further, ability to cut sections of a certain kind with them is easily attained; but to do the best that is possible with them requires as much practice and experience as is necessary for the acquirement of facility in any other line.

There is, however, a limit to the capabilities of these microtomes even in the hands of the skilful and trained manipulator, and it is beyond this that resort has to be made to one of the more complex forms of microtomes, of which so little is known outside laboratories. It is proposed therefore, in a brief way, to mention some of the leading forms of microtomes, and their special features.

Of English make there are but two microtomes that have a right to be reckoned as of the first rank; one is the well-known Cambridge Rocking Microtome, made by the Scientific Instrument Co., of Cambridge, and the other is the "Delepine," made by Messrs. R. & J. Beck. The former is designed especially for the cutting of tissues of small size embedded in paraffin wax, and for that particular purpose it has probably no superiors, and when once its peculiarities and possibilities have been thoroughly grasped, it is capable of work of the highest class.

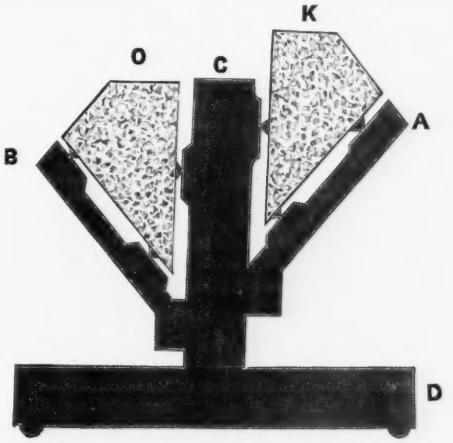
The "Delepine" Microtome, which has been made by Messrs. Beck to the suggestions and designs of Professor Delepine, is intended specially for the cutting of frozen tissues; it is of substantial build and excellent design.

Beyond these, it is necessary to go to the Continent for our wants to be supplied, and all of the makers, which are very limited in number, make instruments which have special points of value for different workers. Some of them are familiar to the ordinary microscopist through their inclusion in English microscopic catalogues, but there are others which are rarely heard of, and are deserving of consideration.

One of the cheapest microtomes that can be considered of a practical description is that made by Schanze, of Leipzig. The jaws will hold an object $1\frac{1}{8}$ inches by $\frac{3}{4}$ inch, and the object can be orientated and fixed in any position. The knife-holder guides consist of three raised rails 7 inches long. Provision is made for the measurement of the thickness of the section by means of the micrometer screw, which is of good construction. The price of this complete is 35s.

Next to this is an exceedingly efficient instrument by Jung, of Heidelberg (his catalogue No. 119), which is provided with an automatic raising arrangement to the object holder of very ingenious description, the knife being brought into action by a swinging movement. It can be used both for embedding and freezing. The price of this in case complete is 50s.

The same maker is responsible for the Rivet Model Microtome, which is considered one of the most generally useful and best machines by a large number of workers. In this, the knife moves in a horizontal plane, and the object in an inclined plane. The accompanying figure gives a diagrammatical view in section of this microtome.



D is the base of the microtome.
C is the central support.

The V guides formed by AC and BC have projecting friction surfaces; while the two blocks O and K, the former the object carrier, the latter for the knife, have fine ivory points where they make contact with the guides.

The V fitting BC is inclined one in twenty, and, obviously, as the block O is caused to move along the groove, the object is raised. A suitable vernier is fitted, which gives exceedingly fine readings for the travelling imparted, which may be effected either by micrometer-screw or hand.

(To be continued.)

MEASURING APERTURES OF OBJECTIVES.—It is generally supposed that the only suitable means obtainable for measuring the apertures of objectives is the apertometer made by Zeiss. Truly, this does work efficiently, yet even with it, marked discrepancies frequently occur between the results obtained by independent observers, and it seems to be peculiarly difficult to secure uniformity, especially with dry objectives having large back lenses and oil immersion lenses. Accuracy with this, as with many other instruments, greatly depends on experience and practice.

The apertometer itself would be so very rarely used by the ordinary worker that it is not considered a necessary adjunct, added to which its expense is in itself an obstacle. This is pointed out in an extremely useful paper by Mr. H. F. Angus, which appears in the *Journal* of the Quekett Microscopical Club for April, 1902; and he further proceeds to suggest ways and means for ascertaining the apertures of dry objectives with very simple means.

The most practical is probably the protractor apertometer, which consists essentially of an ordinary semi-circular protractor mounted vertically on a base with its diametrical edge towards the objective, and having attached to its circumference two

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movable pointed indicators. The following is the method of using it:—

A silvered cover-glass is attached to a piece of glass the thickness of an ordinary slip, the centre of the silver being removed for an aperture of about one mm. The objective is focussed on the centre of the disc, and if the eyepiece then be removed, the whole of that part of the protractor which the objective takes in will be found to be visible at the back of the objective, and if the pointers be set to the edges of the field the reading can be taken. As, however, the image seen will be small, it will be necessary to enlarge it, and this may be done with a supplementary lens, placed at the lower end of the draw-tube, replacing the eyepiece and focussing the image by means of the draw-tube, the moving parts of the microscope being held the while to prevent the objective from being shifted out of focus on the disc.

The lens at the lower end of the draw-tube must be a low power one, such, for instance, as the posterior half of a 2-inch objective. The angular reading thus obtained can be converted into numerical aperture by reference to the tables of comparative angles and N.A., which are to be found in nearly all text books, or by using a table of sines.

It should be mentioned that this system is obviously applicable only to dry objectives, but a ready way of approximately ascertaining the aperture of an oil immersion objective is by placing a piece of tissue paper over the front of the objective, holding it towards the light, and looking through the back lens. If the aperture of the objective exceeds 1·0 N.A., there will be a central annulus of light surrounded by a dark zone; and the greater the width of the dark zone, the more does the numerical aperture exceed 1·0.

The article, in addition, gives some interesting and valuable information founded on a rational basis regarding the proportion of diameter of stop to be used with the condenser to produce background illumination, with a given objective.

NOTES AND QUERIES.

Genl. Warrand.—The gentleman who acts as consultant *re* Rotifers replies as follows:—"I am sorry to say I cannot give you much information about the feeding of Rotifers and other forms of pond life, as I have never been very successful myself. I have kept Melicerta for about three months, and Stephanoceros for two, but that is about all. I keep my bottles filled with water from a rain tub in my garden, and occasionally put in a drop or two of 'soup' made by pulverizing some *Anacharis* in water. I do not think an infusion of hay is the slightest use for the purpose."

A. J. R.—(1) The best condenser for your purpose will be either Baker's achromatic small-sized condenser with a back lens of 22 mm. diameter, or Watson's "Universal." The former is probably the more suitable for your work, because it is more useful for low-power objectives with the top lens removed than the latter. (2) A ½-inch objective by any of the leading makers will give you satisfaction. (3) There are several other processes in the preparation of an insect as a micro object. You could probably gain the information you require from any of the books on mounting objects. (4) The 1-inch objective and "B" eyepiece is the most generally useful for examining crystals with the polariscope.

C. M.—I have submitted your drawing to consultants, and, so far as can be ascertained, it is likely to be that of the Common Phantom Larva, *Corethra plumicornis*. I am much obliged for your kind offer, but the delay that necessarily occurs in replying to queries will probably preclude your gathering them.

F. C. P.—Synapta is a genus of vermiform Echinodermata of the order Apoda. Anchors and plates serve to aid in locomotion, adhesion, and, it is supposed, for impaling food. The species with these plates, &c., are usually of foreign origin.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office*. 326, *High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

SWIFT'S COMET (1895 II.).—This faint comet was discovered in Pisces on 1895, August 20, and observed for several months. Elliptical elements were computed for it by Berberick (period 7·06 years), Boss (period 7·22 years), Schulhof (period 7·19 years), and others. Schulhof's period is liable to an uncertainty of only 15 days. The return of the comet is shortly expected, and the following ephemeris has been computed by F. E. Seagrave, though the conditions are not favourable:—

	R.A.			Dec.			Distance in Millions of Miles.
	H.	M.	S.	°	′	″	
September 2 ...	16	15	55	− 17	54	38	115
,, 10 ...	16	31	10	− 18	46	21	116
,, 17 ...	16	47	55	− 19	34	56	117
,, 24 ...	17	6	1	− 20	18	28	117
October 1 ...	17	25	21	− 20	55	10	118
,, 8 ...	17	45	51	− 21	23	23	118

Thus the comet pursues an easterly course from Scorpio to Sagittarius.

HERVE FAYE.—The death of this eminent French astronomer occurred on July 4th, at the age of 88 years. Born in 1814, Faye's early inclinations led him to the pursuit of astronomy, and on the initiative of Arago he became an assistant at the Paris Observatory. On 1843, November 22, he discovered a small comet with a fan-shaped tail in the northern region of Orion, and it remained visible until 1844, April 10. Dr. Goldschmidt, of Göttingen, and others, computed the orbit, and found it an ellipse of short period (7½ years). M. Le Verrier predicted that the comet would return to perihelion on 1851, April 3, and the prediction was accurately verified by the event. M. Faye was better known as an astronomical writer than as a telescopic observer, though his name has long been familiar to us by its association with one of the most notable and best known of our short period comets. It last returned to perihelion in March, 1896, and its next apparition will occur in the autumn of 1903.

BRILLIANT FIREBALL.—One of those vivid meteoric apparitions which now and then startle observers who are little prepared for such spectacles was presented on Sunday night, July 13th, at 10h. 30m. p.m. The firmament seems to have been clear generally, and the descent of the fireball was witnessed by a great number of persons. The position of the object was over the Straits of Dover, so it was seen in the S.E. sky, the direction of course varying somewhat according to the station. Numerous descriptions of the phenomenon have been published in the newspapers, but 19 out of every 20 of these afford no useful material for computing the meteor's real path in the air. Most of the spectators content themselves with alluding to its sudden and dazzling lustre, to the serpentine trail which lingered for many seconds after the flash, and to the general direction in which it appeared, but give no exact information as to the path traversed. Fortunately, however, a few of those who saw the object were astronomical observers, who recorded its chief features, and amongst these were Mr. W. E. Besley, of Clapham, S.W., Mr. E. Holmes, Hornsey Rise, N., Mr. T. Crumplen, Hungerford Road, N., Mr. E. Rabone, Highgate, N., Mr. E. W. Barlow, Surbiton, Surrey, Mr. W. H. Maw, Outwood, Surrey, Lieut.-Col. Tupman, of Harrow, and the writer at Bristol. It is not essential to give the descriptions in detail, nor can space be afforded for the purpose, but it may be briefly stated that as seen from London the meteor was projected on the sky in the immediate region of the stars forming the constellation Delphinus. Mr. Besley, at Clapham, S.W., recorded the path as from 311° + 21° to 310½° + 16½°, while Mr. Rabone, at Highgate, N., put it as 312½° + 14° to 312½° + 11°. At Bristol the writer registered it as 329½° + 12° to 332° + 8°. The meteor was seen at such distant places as Liverpool, Shrewsbury, Aberdare, and Moreton Hampstead, Devon. Comparing the best observations the radiant point is indicated at 315° + 31° near ζ Cygni, and the meteor fell from 89 to 51 miles from E. of Boulogne, France, to E. of Dungeness, coast of Kent. Path 51 miles, and velocity about 26 miles per second. Had the meteor been able to withstand disruption it would have fallen upon the earth near Uckfield, Sussex. Mr. Besley has also determined the real path, and finds that the meteor descended from a height of 86½ to 52½ miles over 11 miles W. of St. Omer, France, to 11 miles W. of Cape Gris Nez. Length 45 miles, velocity 22½ miles per second. Radiant 316° + 30°. The fireball had rather a short path, and it seems to have been isolated, for no other meteors belonging to the same radiant were seen by the writer at Bristol, either on July 13th, or on the clear nights preceding and following that date.

FIREBALL OF JULY 15TH, 9H. 32M.—Though less brilliant than the fireball of July 13th, this object was conspicuous from its long flight and slow motion. It divided into two near the end of its course. Directed from a westerly radiant in Libra, at about 236° − 12°, it passed over the counties of Essex and Suffolk, descending from 60 to 38 miles in height. Its luminous course was about 51 miles long and velocity 17 miles per second. This real path was computed by Prof. A. S. Herschel, who fortunately observed the meteor from near Windsor, and recorded its flight as from 303° + 33½° to 343° + 39½°, and its duration as three seconds.

THE FACE OF THE SKY FOR SEPTEMBER

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the sun rises at 5.12 A.M., and sets at 6.47 P.M. On the 30th he rises at 5.59 A.M., and sets at 5.41 P.M.

The equinox occurs on the 23rd, when the sun enters the *sign* of Libra, and Autumn commences.

The first and second days of the month are good days for employing the sun to get a meridian line or other similar purposes, for then the equation of time is negligible, the sun being with the clock.

The Zodiacal Light may be looked for in the west after sunset.

Sunspots are very scarce.

THE MOON:—

	Phases.	h. m.
Sept. 2	● New Moon	5 19 A.M.
„ 9	☽ First Quarter	10 15 P.M.
„ 17	○ Full Moon	6 23 P.M.
„ 24	☾ Last Quarter	4 32 P.M.

The Moon is in apogee on the 10th and in perigee on the 23rd.

Occultations.—On the 22nd of the month the double star δ Tauri suffers occultation, whilst on the 13th there is a near approach to β Capricorni. The particulars are as follows:—

Date.	Star Name.	Magnitude.	Disappearance.			Reappearance.			Moon's Age.
			Mean Time.	Angle from N. Point.	Angle from Vertex.	Mean Time.	Angle from N. Point.	Angle from Vertex.	
			h. m.	°	°		°	°	d. h.
Sep. 13	β Capricorni	3·4	6 48 P.M.	347	7	—	—	—	11 13
„ 17	21 Piscium	6·1	11 31 P.M.	359	5	12 3 A.M.	309	309	15 18
„ 22	δ^1 Tauri	4·0	9 2 P.M.	18	55	9 25 P.M.	322	0	20 16
„ 22	δ^2 Tauri	4·7	9 14 P.M.	59	96	10 2 P.M.	281	321	20 16
„ 23	115 Tauri	5·4	10 34 P.M.	130	168	11 12 P.M.	219	259	21 17
„ 26	68 Geminorum	5·0	1 40 A.M.	92	132	2 40 A.M.	278	318	23 20

THE PLANETS.—Mercury is in Virgo, but sets very shortly after the sun.

Venus is in Leo, and is still a very bright object in the early dawn. She rises about two hours in advance of the sun. On the 11th and 12th she is near the star Regulus, whilst on the morning of the 30th she is near the moon.

Mars is a morning star in Cancer, rising about 1 A.M. The apparent diameter is increasing, being now about 4″·5, whilst 0·95 of his disc is illuminated.

Jupiter is a most brilliant object, and on looking southwards, not very high up, his magnificence immediately catches the eye. The planet is on the meridian about 9 P.M. at the middle of the month, and he sets shortly after 1 A.M.; his apparent diameter is now about 43″. On the evening of the 14th he is a little to the east of the moon.

Observing at 9.30 P.M. on the 6th, 7th, 12th, 19th, three satellites only will be visible, the other being in transit, whilst at the same time on the 4th, 15th, 16th, 20th, 24th and 27th one satellite will be in eclipse. On the 23rd, at 9.30 P.M., satellites I. and III. only will be visible, for satellite IV. is in transit and satellite II. is eclipsed.

Saturn is to the westward of Jupiter, and souths about 8 P.M. He forms a very conspicuous object in the sky, not very high up, and shines with a slight reddish tinge. The planet is near the moon on the 12th, and at the stationary point on the 26th. The ring is now widely open, and we are looking down on the northern surface of it. The following are some of the elements for the ring for September 17th:—

Outer major axis, 40″·57.
Outer minor axis, 16″·15.
Elevation of the earth above ring plane, 23° 28′.

Uranus is in Ophiuchus, but sets before midnight. He is therefore not well placed for observation on account of his great southern declination. The planet is in quadrature with the sun on the 11th.

Neptune is visible rather late on in the evening. He is in Gemini, near the stars μ and η Geminorum, and rises about 10.30 P.M. His diameter is about 2″, and he shines with only the brightness of an 8th magnitude star.

THE STARS.—At the beginning of the month, at 9 P.M., the following constellations are to be observed:—

ZENITH . Lyra, Cygnus.
SOUTH . Aquila, Delphinus, Aquarius, Capricornus, Sagittarius; Serpentis, Ophiuchus, and Scorpio, to the S.W.
EAST . Andromeda, Pegasus, Pisces, and Aries; Pleiades on horizon.
WEST . Hercules, Corona, Boötes.
NORTH . Ursa Major, Ursa Minor; N.E., Cassiopeia and Perseus; Auriga (*Capella*) on horizon.

Minima of Algol will occur on the 3rd at 8.0 P.M., 21st at 12.52 A.M., and the 23rd at 9.41 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. Locock, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of August Problems.

No. 10.

Key-move.—1. Kt to Q4.

If 1. . . . P to B3, 2. Kt to K6, etc.
1. . . . P to K4, 2. Kt to B6ch, etc.
1. . . . K to B4, 2. Kt × Pch, etc.
1. . . . K to K5, 2. Q to K6ch, etc.
1. . . . Anything else, 2. Q to K6ch, etc.

No. 11.

The Composer's intention was 1. Q to QB8, but W. Jay has discovered a second solution beginning 1. Q to K7ch, followed by B to B8 or Q to Q6 accordingly. It is a pity that the "much labour" was all in vain.

No. 12.

Key-move.—1. Kt to B6.

If 1. . . . K × Kt, 2. Q to Q3, etc.
1. . . . B × P. 2. Q to R8, etc.
1. . . . B × Kt, 2. Q to QB3, etc.
1. . . . B to Kt2, 2. Q to QKt3ch, etc.

SOLUTIONS received from W. Nash, 4, 4, 4; Alpha, 4, 0, 4; W. Jay, 4, 6, 4; G. Woodcock, 4, 0, 4; G. W. Middleton, 4, 4, 4; C. Johnston, 4, 4, 0; "Looker-on," 4, 4, 4; J. W. Dawson, 4, 4, 4. "Tamen's" solutions were posted too late to score.

Alpha.—In No. 2 you seem to have overlooked the reply 1. . . . P to B7 (dis. ch.), in answer to 1. Kt to K3.

XUM

G. Woodcock.—In No. 2, 1. R to Q8 seems to be answered by 1. . . . B × Kt, 2. Q to Q6ch, K to B4 (!).

J. C. Candy.—Thanks for the problems. If found correct they will appear during the winter.

Note on Problem No. 9.—My decision last month that the duals in this problem were different duals, because they resulted in different mates, was, perhaps, too hasty. As a matter of fact, the stipulation as to the Chess-Editor being the sole judge as to repeated duals was intended rather to apply to the case of a dual in one variation, and the same dual *plus* a triple in another. But the argument in the present case that the dual continuations are the same (the solver having nothing to do with *third* moves) seems unanswerable. I must express, therefore, my regrets to W. Jay, J. W. Dawson, and H. Myers, for having to deduct the extra point scored to them last month.

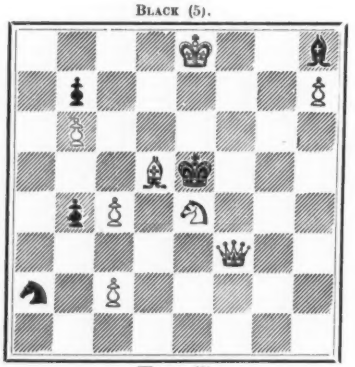
With regard to the judging of the problems, I expect that it will be found necessary to invite the co-operation of those solvers who fail in one problem only, with perhaps the stipulation, in fairness to the composer, that the unsolved problem in each case shall be placed high on the list of the judge who was defeated by it.

PROBLEMS.

No. 13.

"Leonard."

BLACK (5).



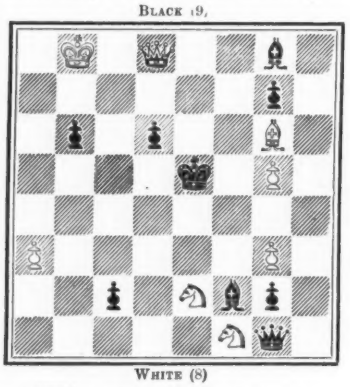
WHITE (8).

White mates in three moves.

No. 14.

"Knowledge rather than choice gold."

BLACK (9).



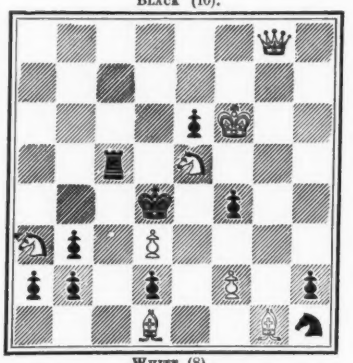
WHITE (8)

White mates in three moves.

No. 15.

"Variety charms."

BLACK (10).



WHITE (8).

White mates in three moves.

CHESS INTELLIGENCE.

The prize-winners in the International Tournament at Hanover, concluded on August 11th, are :—

1.	D. Janowski...	$13\frac{1}{2}$
2.	H. N. Pillsbury	12
3.	H. E. Atkins	$11\frac{1}{2}$
4.	J. Mieses	11
5.	J. N. Napier } J. Wolf }	10
7.	M. Tchigorin	9
8.	Dr. Olland	$8\frac{1}{2}$

The other competitors were F. J. Marshall, J. Mason, I. Gunsberg, C. V. Bardeleben, Cohn, Suchting, Gottschall, Lewin, Popiel, and Swiderski. It is only fitting that Janowski and Pillsbury should fill the first two places, but Mr. Atkins' position, only half a point behind Pillsbury, in this his first appearance in a master-tournament, is a most encouraging sign for English chess. M. Tchigorin recovered somewhat after a very bad start, but Messrs. Marshall, Gunsberg, Mason, and V. Bardeleben, played much below their form. The entry was not nearly so strong as had been expected, and a master-tournament without Lasker, Maroczy, Tarrasch, Schlechter, Blackburne, and Teichmann, cannot by any means be considered representative. Mr. R. Loman obtained 6th prize in the minor tournament. He recently lost a match with Mr. C. H. Sherrard by 4 games to 1, with one draw.

It is probable that the number of players in the North *v.* South Correspondence Match next autumn will be increased to 150 aside. The South have already found more than this number of would-be competitors, and it is probable that the Northerners will prove equally keen.

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